Printed on Thin Paper for Foreign Circulation.

SEP 12 1923

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXVI.—No. 3531] LONDON: FRIDAY EVENING, AUGUST 31, 1923 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

Engineering Library

PUBLIC NOTICES

Assistant Engineer REQUIRED for Railway Construction, NIGERIA, for two tours of 12 to 18 months' service, with possible extension. Salary £480, rising to £720 a year by annual increments of £30, and thence to £920 by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters or an allowance in lieu. Free passages and liberal leave in England on full salary. Candidates, aged 25 to 40, must have had experience of Railway Construction, of Timber Pile Driving and Under-water Work in connection with Slipways, also Concrete Work generally, and more especially in Bridges, Piers and Arched Culverts.—Apply at once in writing, stating age, and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/Nigeria 12,220. 3403

Assistant Engineer REQUIRED for the GOLD COAST, by the ACCRA TOWN COUNCIL, for a tour of not less than 12 nor more than 18 months' continuous residential service, with possible extension. Salary £480, rising to £720 a year by annual increments of £30, and thence to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Liberal leave in England on full salary. Free quarters and passages. Candidates, preferably single, age between 25 and 30, must have had good experience in Municipal Engineering Work, and preferably should possess an Engineering Degree.—Apply at once, by letter, stating age, qualifications and experience, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/12,140. 3415

Assistant Engineer REQUIRED for the GOLD COAST GOVERNMENT RAILWAY, OPEN LINES DEPARTMENT, for two tours of 12 to 18 months each, with possible extension. Salary, £480, rising to £720 a year by annual increments of £30, and thence to £920 by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave in England on full salary. Candidates, 25 to 30 years of age, preferably unmarried, must be Trained Railway Engineers and good Draughtsmen.—Apply at once, in writing, stating age and giving brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/12,207. 3416

Assistant Engineers (THREE) REQUIRED by the GOVERNMENT of HONG KONG, for service in the PUBLIC WORKS DEPARTMENT, for a period of three years, with possible permanency. Salary £480 per annum, rising by annual increments of £20 to £500 per annum, and thence (if appointment is made permanent) to £960 a year. The salary is converted into dollars at the Government rate of exchange at present fixed at 2s. to the dollar. This rate is open to revision. Conveyance allowance of 240 dollars per annum is paid. Free passages provided.

Ref. No. M/12,221 (one vacancy).—Candidates, unmarried, 24 to 30 years of age, must be fully qualified Architects' Assistants, well up in Building Construction and Drainage Work, able to make Surveys and to take Levels. One who possesses a knowledge of the Law relating to Buildings, Public Health and Easements, and who has had experience in the Administration of Building and Public Health By-laws preferred.

Ref. No. M/12,222 (two vacancies).—Candidates, unmarried, 24 to 30 years of age, must be qualified Civil Engineers, with experience of Drainage and Sewer Work and conversant with modern Sanitary Appliances.—Apply at once by letter, quoting clearly the reference number of the vacancy applied for, and stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1. 3401

Assistant Locomotive SUPERINTENDENT REQUIRED for the GOLD COAST GOVERNMENT RAILWAY, for two tours of from 12 to 18 months' service, with possible extension. Salary, £480-£30-£720-£40-£920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages, and liberal leave in England on full salary. Candidates, age between 25 and 35, should be of good education and possess some approved Engineering Diploma. They should have served an apprenticeship in the Locomotive Workshops of one of the British Railways, and have had experience on the Footplate and in Fitting, Turning and Erecting, and in the Patternshop, Foundry and Drawing-office. They MUST have had running experience and should be conversant with Running Shed Procedure and Breakdown Work.—Apply at once by letter, stating age and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/12,103. 3400

Land Surveyor Required by the GOVERNMENT of HONG KONG for three years' service, with prospect of extension. Salary, £400, rising to £530 per annum by annual increments of £20. Salary is converted into dollars at the Government rate of exchange, which is fixed at present at 2s. to the dollar. This rate is open to revision. Free passages provided. Candidates, preferably unmarried, 25 to 30 years of age, must have received a satisfactory training as Land Surveyors and as Draughtsmen. Should possess sufficient knowledge of Astronomy to enable them to lay down a true Meridian Line and ascertain the Latitude. Preference will be given to those who, in addition to having these qualifications, have had considerable experience in Surveying, Plotting and Preparing the Survey Sheets of a large city.

Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/12,177. 3402

Two Assistant Engineer INSPECTORS (MECHANICAL) REQUIRED for home service in the Store Department of the High Commissioner for India. Commencing salary, £150, with prospect of £300/400 on promotion to Inspector, with bonus and pension on Civil Service scale, the commencing salary plus bonus amounting at present to £344. Candidates should be 28/35 years of age, have good technical and shop training, and have held some position of responsibility; all-round rather than specialised experience is desirable. Preference will be given to A.M.I. Mech. E. or equivalent. Previous inspection experience is not essential.

Forms of application and full particulars obtainable from the DIRECTOR-GENERAL, India Store Department, Belvedere-road, S.E. 1. 3391

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Large Steelworks in Scotland (With a Two-Page Supplement).

Shipping, Engineering and Machinery Exhibition at Olympia.

Short Histories of Famous Firms—No. XVII. (SHARP, STEWART & CO.—PART II.).

Visit of American Foundrymen.

Electricity in Coal Mines—No. VI.

Combined Use of Steam for Power and other Purposes.

The American Liner Minnewaska.

PUBLIC NOTICES

City of Cardiff Education Committee.

THE TECHNICAL COLLEGE.

PRINCIPAL: CHARLES COLE, B.Sc. (Lond.).

DEPARTMENT OF ENGINEERING.

HEAD OF DEPARTMENT: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.

SESSION 1923-24.

(Commencing on TUESDAY, 2nd OCTOBER, 1923).

The following Courses have been arranged for Engineering Students:—

A Three Years' Course in Mechanical and Marine Engineering Jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for Students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually and candidates for entry to the above department are eligible to compete.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application forms for Entrance Scholarship Examination, duly filled up, must be received before September 17th.

JOHN J. JACKSON, Director of Education.

City Hall, Cardiff. 3355

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY, extending over either three or four years, are arranged in

CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING

for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' Course provides, in addition to the academic training, opportunity for practical training in "Works."

HEADS OF DEPARTMENTS.

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering.

C. A. GENEVE, B.Sc., A.M.I. Mech. E., Senior Lecturer.

Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.

C. H. LOBBAN, B.Sc., A.M. Inst. C.E., Senior Lecturer.

Professor E. WILSON, M. Inst. C.E., M.I.E.E. (Dean), Electrical Engineering.

E. E. SHAWCROSS, A.M. Inst. C.E., M.I.E.E., Lecturer.

Professor S. A. F. WHITE, M.A.; Professor G. B. JEFFERY, M.A., D.Sc., Mathematics.

Considerable extensions have been made in the Engineering Department. These include a large additional Drawing-office, Lecture Room, and Laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and Research Rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 3052

PUBLIC NOTICES

The Polytechnic, 309, Regent-STREET, W. 1.

SCHOOL OF ENGINEERING.

President of the School: The Hon. Sir CHARLES PARSONS, K.C.B., M.A., LL.D., D.Sc., F.R.S., &c. Head of Department: ALEX. B. HORNE, O.B.E., B.Sc., (Hons., Lond.), F.R.S. (Edin.), &c.

The DAY DEPARTMENT REOPENS on SEPTEMBER 18th, 1923. Entrance Examination commences September 3rd, 1923, at 9.30 o'clock.

Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING.
ELECTRICAL ENGINEERING.
MOTOR CAR ENGINEERING.

Practice in the Laboratories, Drawing-office, Workshop and Field. Fee 21 Guineas per annum.

The EVENING DEPARTMENT REOPENS on SEPTEMBER 24th, 1923. Students enrolled from September 12th, 1923.

The Day and Evening Courses are recognised for the Diplomas and Certificates issued by the Institution of Mechanical Engineers in conjunction with the Board of Education.—Full prospectus free on application to the DIRECTOR of EDUCATION. 3341

The University of Sheffield.

SESSION 1923-24.

Vice-Chancellor:
SIR HENRY HADOW, C.B.E., D. Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the DEPARTMENT of ENGINEERING extend over three or four years and prepare students to become Mechanical, Electrical, Civil or Mining Engineers, or specialists in Fuel Technology or Glass Technology.

The Courses in the DEPARTMENT of METALLURGY cover a period of three or four years and prepare students for positions of responsibility either (1) in Iron and Steel Manufacture, or (2) in the Non-ferrous Metallurgical Industries.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular courses.

In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering and in Glass Technology, arrangements are made to enable students, who come to the University from works or collieries, to take six months' courses of study at the University and six months' practice at the works or colliery each year for a period of four years.

The LECTURE COURSES commence OCTOBER 3rd, 1923.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 25th, 1923.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to

W. M. GIBBONS, Registrar. 3380

University of Manchester.

DEPARTMENT OF ELECTRICAL ENGINEERING.

DEPARTMENTS OF CIVIL, MECHANICAL, AND ELECTRICAL ENGINEERING.

Full particulars of these Courses will be forwarded on application to the INTERNAL REGISTRAR.

The SESSION COMMENCES on OCTOBER 4th. 3360

PUBLIC NOTICES

Heriot-Watt College,

EDINBURGH.

PRINCIPAL—A. P. LAURIE, M.A., D.Sc.

ENGINEERING.

Complete Diploma Courses in MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, and MINING ENGINEERING (COAL, METALLIFEROUS, OIL).

CHEMISTRY.

Courses for Diploma and Associateship of College in Organic and Mineral Chemistry, Metallurgy and Assaying, Oil Technology, Industrial Bacteriology and for the Brewers' Certificate and Brewers' and Analysts' Diploma, also for the Associateship of the Institute of Chemistry (A.I.C.), and for the B.Sc. Degree of Edinburgh University in Technical Chemistry and the B.Sc. Degree of London (Pass and Honours).

The Associateship of the College in Chemistry is recognised by the Institute of Chemistry as exempting from Examinations for the Associateship of the Institute of Chemistry (A.I.C.).

Laboratories equipped for Research Students.

PHARMACY.

Courses for Students preparing for the Professional Examinations of the Pharmaceutical Society of Great Britain ("Qualifying" and "Major" Examinations).

Courses in
BUILDING CONSTRUCTION
for Builders' Clerks and Surveyors, and in
PRINTING
for those engaged in Printing and the Allied Trades.

Entrance Bursary of £25. Schedules on application.

Classes open on 9th October.

Entrance and Bursary Examination commences on 25th September.

Prospectus on application to Principal at the College.

PETER MACNAUGHTON, S.S.C., Clerk.

Heriot Trust Offices, Edinburgh, August, 1923. 3398

City of Bradford.

TECHNICAL COLLEGE.

AMENDED ADVERTISEMENT.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT LECTURER in ENGINEERING DRAWING and DESIGN.

An inclusive salary up to £350 per annum will be paid to a candidate of suitable qualifications and experience.

Full particulars of the appointment and forms of application may be obtained from the Principal of the College. Applications, endorsed "Assistant Lecturer—Technical College," should be returned to me not later than 8th September, 1923.

3394 N. L. FLEMING, Town Clerk.

Finsbury Technical College.

A CHIEF ASSISTANT of graduate rank and with works experience is REQUIRED in the Electrical Engineering Department, to take up duty at the end of September. Salary will be in accordance with the scale adopted by the London County Council.—Applications to be addressed to Dr. W. H. ECCLES at the College and received not later than the 5th September next. 3330

Finsbury Technical College.

APPLICATIONS are INVITED for the undermentioned POSTS in the Department of Civil and Mechanical Engineering and Applied Mathematics:—

(1) LECTURER in MATHEMATICS and APPLIED MECHANICS. Applicants should be of graduate rank and should have special knowledge of the requirements of engineering students.

(2) ASSISTANT INSTRUCTOR in MECHANICAL DRAWING. Practical experience in engineering work shops and drawing-offices is essential.

The duties of the posts will commence at the beginning of October next.

The salaries attached to the posts will be in accordance with the London County Council scale of salaries for teachers in technical institutions.

Applications, with copies of testimonials, particulars of teaching and professional experience, should be addressed to Professor H. F. PHILPOT, Finsbury Technical College, Leonard-street, City-road, and should be received not later than 5th September, 1923. 3331

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.

SITUATIONS WANTED, Page 2.

PARTNERSHIPS, Page 2.

PATENTS, Page 3.

MACHINERY, &c., WANTED, Page 3.

FOR SALE, Pages 3, 4 and 98.

AUCTIONS, Page 98.

PREMISES TO LET OR WANTED Page 98.

WORK WANTED, Page 4.

AGENCIES, Page 3.

MISCELLANEOUS, Page 3.

For Advertisement Rates see Page 229, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page 97.

PUBLIC NOTICES

The Yarrow Scholarships.

The Council of the Institution of Civil Engineers are prepared to consider APPLICATIONS for NOMINATIONS to the above SCHOLARSHIPS. These should be submitted before the 1st October, 1923, to the SECRETARY of the INSTITUTION, at Great George-street, Westminster, S.W. 1, from whom the detailed regulations may be had on application.

The Yarrow Scholars must be British subjects, who, desiring to become engineers, lack sufficient means to enable them to pursue their practical or scientific training.

The Scholarships are of a value varying from £50-£100 per annum. 3185

University College of South WALES AND MONMOUTHSHIRE

(COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY).

The Council of the College invites APPLICATIONS for the POST of ASSISTANT LECTURER and DEMONSTRATOR in ENGINEERING. Three copies of applications, with testimonials, which need not be printed, must be received by the undersigned on or before September 15, 1923.

Further particulars regarding the above post may be obtained from the undersigned.

D. J. A. BROWN, Registrar.

University College, Cardiff, August 20th, 1923. 3336

Agent-General for Victoria (AUSTRALIA),

MELBOURNE PLACE, STRAND, LONDON, W.C. 2.

CONSTRUCTION OF BRIDGE FOR COUNTRY ROADS BOARD, VICTORIA.

TENDERS, addressed to the Agent-General and endorsed "Tender for Barwon River Bridge," will be received at this office until Twelve o'clock Noon on Wednesday, 24th October next, for the ERECTION of a BRIDGE over the Barwon River at Geelong, Victoria, consisting of 417 Lin. Ft. of Deck Plate Girder Bridge, with Concrete Deck: 1200 Lin. Ft. of Approaches and 16,000 Cubic Yards of River Excavation.

Plans and specifications may be inspected at this office. The lowest or any Tender not necessarily accepted. Preliminary deposit £500. 3332

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for:
(1) SPRING STEEL.
(2) MILD STEEL BARS, PLATES, SHEETS and SECTIONS.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Friday, 24th August, 1923.

A fee of £1 1s. will be charged for each specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Tuesday, 4th September, 1923.

The Directors do not bind themselves to accept the lowest of any Tender.

By Order of the Board,
R. C. VOLKERS,
Secretary.

3387

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for:
67ft. CARRIAGE UNDERFRAMES (without Wheels and Axles).

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Monday, 27th August, 1923.

A fee of £1 1s. will be charged for the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Monday, 10th September, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
R. C. VOLKERS,
Secretary.

3404

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive up to Noon on Tuesday, 18th September, TENDERS for the SUPPLY of—

1. STEEL MATERIAL.
2. WHEELS and AXLES for CARRIAGES and WAGONS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices: 91, Petty France, Westminster, S.W. 1, 28th August, 1923. 3420

County Borough of Tynemouth.

TENDERS are INVITED for the CONSTRUCTION of a ROAD (25ft. wide and about 700 yds. in length) and of SIX BRIDGES, the site of the works being in the vicinity of Northumberland Dock, in the Borough of Tynemouth.

Drawings and specification may be seen at the office of the undersigned, where, upon payment of Two Guineas, two copies of the bills of quantities may be obtained. The Two Guineas will be returned upon a bona fide Tender being received.

Tenders, which must be on forms which will be supplied with copies of the bills of quantities and be enclosed in sealed envelopes, endorsed "Tender to Construct Northumberland Dock Road," are to be delivered at the aforesaid office by, at latest, 10 a.m. on Saturday, the 8th September.

No pledge is given to accept the lowest or any Tender.

JOHN F. SMILLIE, Borough Surveyor.

Tynemouth (Office at North Shields). 3291

The South Indian Railway COMPANY, Limited,

are prepared to receive TENDERS for the SUPPLY of—

1. FOUR-WHEELED STEEL BRAKE VANS and BOGIE STEEL HIGH-SIDED WAGONS.
2. YORKSHIRE IRON.
3. SOLID DRAWN STEEL BOILER TUBES.
4. GALVANISED CORRUGATED SHEETS, &c.
5. MILD STEEL BARS, SECTIONS, &c., for Miscellaneous Purposes.
6. COPPER TUBES, BRASS SHEETS, &c.
7. SPRING STEEL.
8. SAWS.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Steel Brake Vans and Wagons" (or as the case may be), must be left with the undersigned not later than Twelve Noon on Friday, the 28th September, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of—

£1 for each copy of Specification No. 1
10s. " " Nos. 2, 3, 4 and 5
5s. " " No. 6
2s. 6d. " " Nos. 7 and 8

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, S.W. 1. 28th August, 1923. 3421

PUBLIC NOTICES

County Borough of Halifax.

The Tramways and Electricity Committee of the Halifax Corporation invite TENDERS for the SUPPLY of the following PLANT required in their Electricity Department:—

CONTRACT NO. 56.—ONE 10,000 K.W. TURBO-ALTERNATOR complete with CONDENSER.

Specifications and form of Tender may be obtained on application to Mr. W. M. Rogerson, M.I.E.E., Borough Electrical Engineer, Electricity Offices, 29, Northgate, Halifax.

Tenders, endorsed "Electricity Works, Contract No. 56," must be sent to the undersigned not later than Twelve o'clock Noon on Friday, the 7th day of September, 1923.

The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

The Committee do not bind themselves to accept the lowest or any Tender.

The placing of the contract will be subject to the consent of the Electricity Commissioners.

By Order,
PERCY SAUNDERS, Town Clerk.

Town Hall, Halifax, 11th August, 1923. 3295

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for:
NINE LUGGAGE VAN UNDERFRAMES, FOUR-WHEELED, without Wheels and Axles (metre gauge),

in accordance with the specification which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 18th September, 1923, and marked "Tender for Underframes."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road, Westminster, S.W. 1,
27th August, 1923. 3408

UNION INFIRMARY, STOTT-LANE, WEASTE. The Salford Board of

Guardians invite TENDERS for HEATING and HOT WATER SERVICE APPARATUS, including Calorifiers, Pumps, Mains, Radiators and the like for the above Infirmary and Nurses' Home Extension.

Drawings of the plant may be inspected at the offices of the Engineer, Mr. T. Roland Wollaston, M.I.M.E., Lord's Chambers, 26, Corporation-street, Manchester, on or after Monday, August 27th, between the hours of 10 a.m. and 4 p.m. Specification, form of Tender and conditions of contract may be obtained from the undersigned on receipt of written application, enclosing cheque value Two Guineas, which sum will be refunded on due receipt of bona fide Tender.

The Board do not bind themselves to accept the lowest or any Tender. The selected contractor will be required to subscribe to the conditions as regards employment of labour, &c., as set forth in the Board's regulations.

Sealed Tenders, endorsed "Engineering, Section 2," must be delivered at my offices not later than 10 a.m., on Saturday, September 22nd, 1923.

E. H. INCHLEY, Clerk to the Guardians.

Poor Law Offices, Eccles New-road, Salford, 23rd August, 1923. 3388

The Watchet Urban District

Council is prepared to receive TENDERS for the CONSTRUCTION of certain WORKS, including a Concrete Quay, Sheeting and Bulkhead Walls, &c., for the improvement of the harbour at Watchet, Somerset.

The form of Tender, terms and conditions of contract, specification, bill of quantities, and drawings may be obtained from the office of the undersigned. The charge for these will be One Guinea, which is non-returnable.

Sealed Tenders, endorsed "Watchet Harbour Improvement," must be delivered to this office on or before Monday, the 24th September, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

FRANK HISDON, Clerk.

Office of the Urban District Council, Watchet, Taunton, Somerset. 3397

Windsor Board of Guardians. HEATING, LIGHTING AND POWER FOR INSTITUTION.

The Guardians of the Windsor Union invite TENDERS for the SUPPLY and ERECTION of STEAM BOILER, HEATING, COOKING, LAUNDRY and ELECTRIC LIGHTING INSTALLATIONS at the Windsor Poor Law Institution, Old Windsor, Berks. For specification, conditions, drawings and form of Tender apply to the Consulting Engineer, Mr. W. W. Nobbs, M.I. Mech. E., 50, Fairhazel-gardens, London, N.W. 6, on or before Monday, September 10th, 1923.

The sum of £1 1s. will be required to be paid to the above-named Engineer at time of application, and he will return same to contractors sending bona fide Tenders.

Sealed Tenders must reach me by Monday, the 24th September, 1923, marked "Heating, Lighting, &c."

The Guardians do not bind themselves to accept the lowest or any Tender.

J. E. GALE, Clerk to the Guardians.

16, Sheet-street, Windsor, 28th August, 1923. 3410

SITUATIONS OPEN

ENGINEERS.—TWO YOUNG MEN REQUIRED for Havana branch office of leading American firm Consulting Engineers, specialising in Sugar Machinery; must have good general education and thorough technical education, preferably college graduates, in Steam, Mechanical, Electrical, Structural Engineering; knowledge of Spanish and some Chemistry advantageous. Give full information training, shop and drawing-office experience, salary expected. Excellent opportunity for advancement to responsible positions.—Address, P7927, The Engineer Office. P7927 A

REPRESENTATIVE WANTED for London; must have good knowledge of Engineering Business and know how to get business for Malleable and Grey Iron Castings, Aluminium and Gun-metal Castings and General Engineering Work. Whole or part-time service would be considered, according to propositions applicants may be able to put forward.—ALFRED DANKS, Ltd., Emlyn Works, Gloucester. 3414 A

REQUIRED for the Middle East, MECHANICAL ENGINEER, with experience of Erection and Maintenance of Tea and Rubber Factories and Internal Combustion Engines; age not over 28.—Address, with copies only of testimonials, stating whether married or single, P7935, The Engineer Office. P7935 A

TWO or THREE TECHNICAL ASSISTANTS REQUIRED in a Railway Civil Engineer's Office in England; must be good practical men of experience, with theoretical knowledge, and Associate Members of the Institution of Civil Engineers.—Write, stating full qualifications and experience, age, and salary required, to 3422, The Engineer Office. 3422 A

WANTED for a Firm of Structural Engineers in India, First-class DRAUGHTSMAN, capable of Designing and Estimating for all types of Structural Work, including Bridge Work. Must be unmarried. Five years' agreement. Good terms for suitable applicant. Yorkshireman preferred.—Write, with copies of testimonials and state salary required, to E. S. 506, c/o Deacon's, Leadenhall-street, London. 3382 A

SITUATIONS OPEN (continued)

WANTED, CHIEF DRAUGHTSMAN for Large Steel Works in Yorkshire. State age, experience, and salary expected.—Address, 3384, The Engineer Office. 3384 A

WANTED, HEAD EXPERT DESIGNER for Woodworking Machinery by first-class makers. Generous terms to suitable applicant.—Apply, stating age, qualifications, references, and salary required, to Box 161, Willing's, 30, King-street, Covent Garden, W.C. 2. 3346 A

WANTED in the Midlands, a First-class DRAUGHTSMAN, accustomed to Light Railway Carriages and Wagons.—Address, stating age, experience and salary required, P7941, The Engineer Office. P7941 A

WANTED, STEEL CONSTRUCTION DESIGNER for Engineers in Eastern Counties.—Address stating age, particulars and salary required, 3430, The Engineer Office. 3430 A

DRAUGHTSMAN, First-class, WANTED; Capable of Designing Gasworks Plant, particularly Gas holders, Purifiers, Condensers, &c. None but efficient men having the necessary qualifications need apply.—ASHMORE, BENSON, PEASE and CO., Ltd., Stockton-on-Tees. 3320 A

DRAUGHTSMAN REQUIRED to Take Charge of Structural Steel Department.—Apply, stating age, full qualifications, experience, and salary required, also references, to NORTONS (TIVIDALE), Ltd., Tipton. 3343 A

DRAUGHTSMAN, STRUCTURAL, DESIGNER. Capable YOUNG MAN WANTED for works, South England; experienced in Light Structural Steelwork; able to design this class of work on own responsibility. State age, experience, technical training and salary.—Address, 3433, The Engineer Office. 3433 A

DRAUGHTSMAN WANTED with Railway Locomotive and/or Omnibus Experience.—Address, stating experience and salary wanted, P7925, The Engineer Office. P7925 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED; none but experienced men need apply. State full particulars, age, salary required.—THE CLEVELAND BRIDGE and ENGINEERING CO., Ltd., Darlington. 3311 A

MECHANICAL and STEAM ENGINEER-DRAUGHTSMAN, about 27/30, sound technical training, D.O. experience in Boiler Plant Lay-out, Works Experience, Boiler and Stoker Erection and Operation; able to take complete tests and assist with Correspondence. Birmingham first, London later. Good prospects for energetic, enthusiastic and loyal co-operator. Fullest possible particulars, with salary required.—Address, 3411, The Engineer Office. 3411 A

ROPEWAY ERECTOR.—Thoroughly Experienced WORKING ERECTOR REQUIRED to Dismantle Aerial Ropeway and to Erect same on a new site.—Address, stating full details of previous experience, salary required, &c., P7954, The Engineer Office. P7954 A

SEVERAL Experienced DRAUGHTSMEN for Large Electrical Machinery with London firm.—Address, stating age, training and experience in full, 3389, The Engineer Office. 3389 A

SHIP DRAUGHTSMAN (HEAD) WANTED by Shipbuilders in Shanghai; aged about 33; must have held similar position before; salary commencing £540.—Write, detailing experience, to DRAUGHTSMAN, care Abbott's, Eastcheap, London, E.C. P7936 A

WANTED, FOREMAN of WORKS; Coastal Man preferred, for Branch of Public Service. Permanency for man of proved capacity. Essential qualifications:—Comprehensive knowledge of building construction in all its branches, ability in preparation of rough scale drawings, including details of carpenters' and joiners' work; setting out, measuring up, accounts, reports, supervision of contract work, execution of work with direct labour, control of men, able to scheme out methods and assume responsibility. Habits and integrity must bear strictest investigation. Conscientious execution of highest-class work only during prolonged spells of absence of supervision. Age about 40. Pay 6 guineas per week. Write, with short statement of experience and copies only of recent testimonials.—Address, 3371, The Engineer Office. 3371 A

SITUATIONS WANTED

A. M.I.C.E. (32), Appreciated Crewe Works, 2 Yrs D.O., assistant and charge of locomotive steam sheds; automobile and gas engine, constructional, maintenance of plant, general engineering, correspondence and commercial experience, control of large staffs, wide technical knowledge. DESIRES POST with prospects.—Address, P7962, The Engineer Office. P7962 B

ASSOC. M. Inst. C.E., with Exceptional Experience, practical and theoretical, in heavy steel bridge and structural work, and a good knowledge of ferro-concrete and civil engineering, DESIRES an APPOINTMENT.—Address, P7955, The Engineer Office. P7955 B

ASSISTANT SUPT. ENGINEER and DRAUGHTSMAN, with city consulting marine engineer's experience, SEEKS POST; had charge of running and upkeep of a fleet of motor-driven cargo vessels, semi and Diesel engines.—R., 15, Lonsdale-square, Barnsbury. P7950 B

CIVIL ENGINEER DESIRES POSITION in London or district, either on construction work or as a general draughtsman; also good surveyor and leveller.—Address, P7945, The Engineer Office. P7945 B

CIVIL ENGINEER, with Exceptional Experience in the design of reinforced concrete structures, SEEKS A POSITION of RESPONSIBILITY in South America.—Address, P7959, The Engineer Office. P7959 B

CIVIL ENGINEER (37), Ten Years' Railway Experience, three years manager, sugar factory, Brazil; four years' war service; fluent Portuguese, health excellent, highest references, accustomed position authority. Good salary required. At present in Brazil and available in 1924.—Address, P7931, The Engineer Office. P7931 B

ELECTRICAL and MECHANICAL ENGINEER, with 27 years of practical and commercial experience, is now OPEN for APPOINTMENT, England or abroad; highest references given.—Address, P7939, The Engineer Office. P7939 B

ENGINEER, with Wide Marine, D.O., Mechanical and electrical experience, DESIRES APPOINTMENT where experience can be fully utilised. Held positions as works and chief engineer; at present engineer medium-sized works; Extra 1st Class Eng., B.O.T. Irreproachable testimonials; age 34.—Address, P7910, The Engineer Office. P7910 B

ENGINEER (29), with All-round Experience, including pattern-making, drawing-office, fitting and surface table; excellent refs. DESIRES POST home or abroad.—Address, P7947, The Engineer Office. P7947 B

EXPERIENCED ENGINEER, A.M.I. Mech. E., M.I. Mar. E., extra 1st B.O.T., WISHES to COMMUNICATE with established firm of CONSULTING ENGINEERS, AUCTIONEERS and VALUERS of Engineering Plant, with a view to APPOINTMENT and possible PARTNERSHIP.—Address, P7949, The Engineer Office P7949 B

SITUATIONS WANTED (continued)

FOUNDRY AND/OR LIGHT ENGINEERING TRADES.—GENTLEMAN (37) DESIRES RESPONSIBLE POST as General, Sales or Commercial Manager; thoroughly experienced; not afraid of work; progressive proposition wanted.—Address P7958, The Engineer Office. P7958 B

GRADUATE in Marine Engineering, Age 24, DESIRES POSITION (ashore, home or abroad); preferably as a maintenance engineer; 6 years' practical experience.—Address, P7961, The Engineer Office P7961 B

MECHANICAL ENGINEER.—YOUNG MAN (23) DESIRES SITUATION; 4 years' engineering college training, including one session at works.—V. E. W., 34, Hart-road, Dorking. P7946 B

MECHANICAL ENGINEER (29), O.I. Mech. E., passed A.M.I.M.E. exam., over 7 years' practical experience, including 6 years apprenticeship, 3 years engineering college, SEEKS PROGRESSIVE POSITION; ambitious, conscientious worker.—Address, P7937, The Engineer Office. P7937 B

MECHANICAL ENGINEER (23), Sound Education, engineering technology, 3 years' machine shops exp., all machine tools, gear cutting, heat treatments, M.I.S.I., DESIRES RESPONSIBLE JOB, preferably one that necessitates special application and study.—P. W., 10, Lampmead-road, Lee, S.E. 12. P7926 B

MECH. ENG. (32), Public School Man, Served Time in well-known loco. works, studied for B.Sc. degree at American University, last year interrupted by war, varied shop and office exp. at home and abroad, excellent testimonials, SEEKS RESPONSIBLE POSITION.—Address, P7928, The Engineer Office. P7928 B

APPRENTICE FITTER (21), Glasgow, 3½ Years' shop experience, DESIRES SITUATION in London drawing-office till completion of his time; energetic, good education, knowledge French and German, I.C.S. student; available fortnight's notice.—Address, P7932, The Engineer Office. P7932 B

DRAUGHTSMAN, SENIOR, DISENGAGED. An experienced practical engineer; general engineering, designing, working drawings, &c.; is a willing and active worker, with initiative.—Address, P7951, The Engineer Office. P7951 B

DRAUGHTSMAN (23), with 6 Years' Experience in jig and tool and general engineering, SEEKS POST with firm in the Midlands; good refs.—Address, 8, M., 199, St. Agatha's-road, Ward End, Birmingham. P7956 B

JUNIOR (18) SEEKS SIT. in Engineers' D.O.; 4 years' tech. educ., knowl mechanics, heat eng., and D.O. routine.—S. L., 22, Manchester-street, S.W. 1. P7934 B

STRUCTURAL DRAUGHTSMAN DESIGNER, Details, quantities; (27.) 6 years' general experience, university training, SEEKS APPOINTMENT; salary £4 10s.—Address, P7942, The Engineer Office. P7942 B

FIRST-CLASS MOULDER (34) REQUIRES RE-ENGAGEMENT as FOUNDRY FOREMAN (non-ferrous alloys); 6 years' ex. ref., experienced mixing to attain specified strength.—Address, P7943, The Engineer Office. P7943 B

FOREMAN of WORKS SEEKS RE-ENGAGEMENT at home or abroad; well up in all branches of building construction, reinforced concrete roads, engine beds, boiler setting, furnace building, &c.; undeniable refs.—Address, P7944, The Engineer Office. P7944 B

FOUNDRY FOREMAN (39), Malleable, Grey Iron, brass, specialist mac. plate moulding, able take complete control, good organiser; ex. ref.—Address, P7897, The Engineer Office. P7897 B

MACHINE SHOP FOREMAN DESIRES RE-ENGAGEMENT; age 32; last situation 5½ years, conversant with modern methods repetition production; strict disciplinarian and timekeeper, and possessing initiative; home or abroad.—Address, P7929, The Engineer Office. P7929 B

COMMERCIAL RECONSTRUCTIONS, LTD.,

1, POST OFFICE CHAMBERS, DERBY.

The Company takes hold of substantial, non-paying concerns and re-organises and revitalises them, both technically and financially, to the dividend-paying stage.

The fullest investigations are invited and required.

PARTNERSHIPS

PARTNERSHIPS ENGINEERING AND BUSINESSES.

Wheatley Kirk, Price & Co.

46, Watling Street, London, E.C. 4.

Established seventy years.

ELECTRICAL AND MECHANICAL ENGINEERING.—A firm of Railway, Mining and Building Material Merchants in Durban, South Africa, REQUIRES a PARTNER who has thorough knowledge Electrical and Mechanical Engineering; capital required £500 to £1000. Thorough investigation allowed.—Apply, STOCKEN, Solicitors, 49, Leadenhall-street, E.C. P7953 C

ENERGETIC MAN, Preferably Engineer with Commercial experience, is INVITED to ASSIST in EXTENDING the very profitable BUSINESS of old-established registered company pipe for great development. If mutually satisfied, directorship could be arranged.—£2000 incoming.—Address, P7957, The Engineer Office. P7957 C

OLD-ESTABLISHED CHEMICAL ENGINEERS have OPENING for YOUNG GENTLEMAN to learn special business and eventually take up commercial position abroad; must be prepared to deposit £1000 to be repaid in salary.—Address, 3424, The Engineer Office. 3424 C

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—B. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No., 378 Hop. 822 E

FOR SALE or HIRE, ELECTRIC MOTORS, from 40 to 200 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. WILLIAMS and SONS, 27, Queen Victoria-street, London, E.C. Tel., City 3046. Ex

For continuation of Small Advertisements see page 3

A Seven-Day Journal

Picking Up Mails in Flight.

Experiments, it is reported, have recently been successfully carried out by the Royal Air Force to demonstrate the possibility of picking up mails and message-bags by an aeroplane in full flight. Trials, it is understood, were first made in Mesopotamia, and have been completed at Portsmouth, South Farnborough and elsewhere. The ability to pick up a bag of mails or messages from the ground by an aeroplane in flight should go a long way towards increasing the value of aircraft as mail carriers, for hitherto the time and expense involved in getting the mail to a specified aerodrome and collecting it from the same spot has largely offset the advantage represented by the carriage of the mail at high speed through the air. The primary object of the experiments was, however, to increase the value of aircraft when operating with troops on the ground. They were designed to supply a method whereby communication could be established with troops isolated at a point possessing no facilities for the landing of an aeroplane.

Engineers on Motor Ships.

The difficulties in connection with the supply of engineer officers for motor ships have been the subject of discussion for some considerable time. In the early days of this class of vessel the Mercantile Marine Department of the Board of Trade granted certificates of competency as determined by a candidate's knowledge and experience of steam engines, but it was subsequently decided that a separate class of certificate should be instituted, to be valid on motor ships only. It was announced that after the close of 1921 ordinary steam certificates would not be valid on motor ships, but before the end of that year it was found that the number of engineers to whom motor ship certificates had been granted was quite insufficient to meet the requirements of the motor ships then in service or under construction. As an outcome, it was decided to extend the transitional period to the end of this year. While the Board of Trade considers that it cannot properly sanction any further extension, others interested in the subject are desirous of securing modification. On Wednesday a conference between the Board and interested parties was held to discuss the matter thoroughly, but at the moment of writing the Board's decisions have not been announced.

H.M.A.S. Australia.

The Australian Commonwealth battle-cruiser Australia, it is announced, is to be broken up. This vessel, a sister ship of H.M.SS. Indefatigable and New Zealand, was built at Clydebank in 1912. She carries eight 12in. and sixteen 4in. guns, and has a speed of 26 knots. During the war her most notable service was the part she took in the expedition against Samoa, which led to the surrender of the possession on August 13th, 1914. Thereafter, she was engaged in driving von Spee's squadron to the Falkland Islands, where it was encountered and destroyed by Admiral Sturdee's vessels. Subsequently, she joined Admiral Beatty's battle-cruiser squadron in home waters, but was four days too late to take part in the Dogger Bank action. She then became flagship of the second battle-cruiser squadron, under Vice-Admiral Pakenham, but was not present at the Battle of Jutland.

Gliders at Vauville.

Starting in a dead calm, when for two weeks gliding was out of the question, the meeting at Vauville, near Cherbourg, ended under particularly favourable conditions, and the second half of the competition witnessed some very interesting gliding and flying. The most striking feature of the Vauville tests was the failure of gliders and small aeroplanes that differed from the definite types of monoplanes and biplanes with which it has been alone possible, so far, to obtain satisfactory results. A curious triplane glider designed according to a new formula crashed on its first attempt to rise from the ground. Gliders with flexible bird-shaped wings proved hopeless failures. The only machines with which flights could be made were the monoplanes of Dewoitine, Poncelet and others and the tandem plane of Peyrot, upon which Maneyrol has done so much consistently good gliding and flying. These machines were launched in the air down-hill towards the sea by means of a long elastic cable attached to a hook under the machine, and the ends pulled to give the required tension while the machine itself was anchored. The small monoplanes were invariably successful, and Simonet and Maneyrol on his tandem machine remained in the air for hours when the wind was sufficiently strong. They could not, however, leave the ascending current above the cliffs, and had to creep along the coast or remain motionless. In the present state of the art, gliding is only possible if the air currents are known, and it has therefore no practical utility as an instrument of flight, although it is claimed to offer an invaluable means of getting down to a greater refinement in aerofoil design. The weight of the Poncelet monoplane, piloted by the Belgian Simonet, was about 85 kilos., and it was loaded to 8 kilos. per square metre. The load of the Peyrot tandem machine, piloted by Maneyrol, was 11 kilos. per square metre of surface. Among the machines fitted with small engines, that piloted by Barbot—the Dewoitine—flew 214 kiloms., and others also travelled long distances with extremely low fuel consumptions. It would appear as if progress in cheap flight with small aeroplanes now depends upon the engines and propellers. Simonet went to Vauville with a motor cycle engine on his Poncelet monoplane, but as one of the cylinders broke he had to content himself with gliding. The small propellers do not appear to have a high efficiency, and judging from the facts observed at the Vauville meeting, more research is needed in engines and propellers than in connection with the gliders, which, so far at least as the monoplane type is concerned, are already giving quite satisfactory results.

Another French Aeroplane Disaster.

On Monday afternoon a very serious accident occurred on the London–Paris air route, and once again the machine involved was a French one, a Farman Goliath belonging to the French Air Union. This machine left Paris for Croydon at 12.45 p.m., carrying a pilot, a mechanic and nine passengers. At Lympne a short halt was made, as a result, it is understood, of some slight trouble. On continuing its journey, trouble again appears to have developed, when the machine was some five or six miles from Maidstone. At about 5.30 p.m. it was observed flying low, apparently out of control and with the engines missing fire, and from a height of about 100ft. it was seen to nose-dive and crash to the earth. One passenger, it was found, had been killed, while all the others on board had been more or less seriously injured. The cause of the accident will, no doubt, be made the subject of close inquiry. Meanwhile, it may be noted with satisfaction that when it crashed, the machine did not catch fire.

A Hundred Years Too Late.

On Thursday of last week the *Sheffield Independent* reproduced from its issue of August 23rd, 1823, the following advertisement as an item of interest:—"Workmen Wanted.—Smiths and stove grate fitters, of sober habits, should apply to Newton, Scott, Chambers and Co., Thorncliffe Ironworks, near Sheffield, where they will meet with liberal encouragement." We are informed by Newton, Chambers and Co., Limited, that on Friday morning they received a number of "replies," among which were some which stated that the applicants had "never touched beer in their lives." The firm was established in 1793, and still makes stove grates, but most of the smiths in its employment are engaged in its constructional steelwork department, and for the most part work on a material that was quite unknown at the date of the advertisement.

Smokeless Fuel Experiments in Glasgow.

Under the auspices of the Gas Committee of the Corporation of Glasgow, it is proposed to conduct experiments on the production of smokeless fuel at the Dalmarnock works. The experiments are to be made by the low-temperature carbonisation process in the existing vertical retorts used at the works for making gas, and also in a five-unit battery of Maclaurin producers to be erected, the gas produced from which is to be used by the Electricity Department to fire some of its boilers. The proposal to conduct the experiments is the outcome of recommendations made by the Sub-committee on Smokeless Fuel, a body which has been studying the subject since 1909, with the object of taking a step towards freeing the atmosphere from pollution. The Maclaurin producer was first tried at Stirling and then at Grangemouth, where a plant exists capable of carbonising from 20 to 24 tons of coal per day. It is stated that the results obtained have been successful with all classes of coal, and that it is possible in the one plant to produce either soft fuel for domestic purposes or hard coke for metallurgical use. The gas produced is said to have a calorific value of 250 British thermal units per cubic foot, about half the value of ordinary town's gas, but that with coal at 20s. per ton at the works and the fuel produced realising 28s. 6d. per ton, the gas could be sold at about 2¼d. per 1000 cubic feet or a penny per therm.

French State Railway Control.

The decision of the French Government to ignore the refusal of the Conseil Supérieur des Chemins de Fer to reduce the railway rates on wines has given rise to severe criticism on the ground that by imposing changes in the rates the Government has shattered the authority of the Council. When it was decided to centralise the French railway organisation in a Conseil Supérieur, composed of representatives of the companies and of railwaymen, of the different categories of the railway-using public, and of State Departments, it was understood that the Council would carry on its work without State interference, beyond the authority vested in the State representatives on the Council. So far this system of central railway control has given very good results, especially in securing working economies and bringing down expenses to below receipts, to the extent that most of the companies seem to be emerging at last from an interminable period of financial deficit. This result has been achieved partly by a careful adjustment of the rates to meet the situation. The viticulturists in the south, finding themselves with a surplus of wine, requested the Government to secure a reduction in the freights on wine as a means of disposing of the excess supplies. The Conseil Supérieur was of the opinion that the reduction in rates, while putting money in the pockets of viticulturists, would not benefit the consumer, and would be detrimental to the interests of the companies. It was regarded as nothing more than a political move. The Council thereupon refused to reduce the rates, despite the urgent representations of the Government, and the Minister of Public Works has therefore imposed the reduction upon the companies. The viticulturists have obtained satisfaction, but the Conseil Supérieur des Chemins de Fer finds itself henceforth at the mercy of the State.

Successful Salvage Work.

When the White Star liner Laurentic was torpedoed by a German submarine off Lough Swilly in January, 1917, she carried with her to a depth of 20 fathoms bar gold and silver specie valued at some five million pounds, consigned by the British Government to American bankers. Since 1918 salvage work has been in progress each year from the end of March until the weather broke up for the winter. The operations have been conducted from the Admiralty salvage steamer Racer, and have been carried out by ten naval divers, assisted by fifty merchant seamen. Up to August last year, £1,600,000 of gold and silver had been recovered, but during the present season the work of recovery has proceeded at an accelerated pace. In the early days of this month the amount recovered was valued at over £3,800,000, and since then several more good finds have been recorded. It is stated, in fact, that all the silver has now been brought to the surface, and that all the gold has been recovered except some 180 bars. The operations have been attended by considerable difficulties, for although the depth is not unduly great, there is a strong current at the scene of the wreck, and the bed of the sea is far from being level. Moreover, the ship's boilers have broken loose from their fastenings, and have battered the hull, and at times nearly crushed the divers. No untoward incident has, however, occurred, and it is expected that the operations will be completed by the end of September.

Converting U.S. Steamers to Motor Ships.

According to a report from New York, a number of American shipowners have approached the United States Shipping Board with a scheme for the purchase of ten to fifteen of that Board's steamers, with a view to converting them to motor ships. The vessels in question are of 8000 to 9000 tons measurement, and have so far not found purchasers, because they are declared to be over-engined and over-boilered, and as a consequence to be abnormally costly to operate. The scheme contemplates the replacement of the steam machinery by motors of about 2500 horse-power running at 90 revolutions per minute. It is, further, proposed to retain a portion of the existing boiler plant, to heat it by the exhaust from the motors, and to use the steam generated for lighting and heating purposes, and for the operation of the auxiliaries. The suggested sale price for the vessels as they exist to-day is 5 dollars per ton. When converted and overhauled, they are estimated to represent a total expenditure by the purchasers of from 40 to 50 dollars a ton. The present market value of similar motor ships is declared to be about 70 dollars per ton. German and Scandinavian firms are, it is said, among those that have been asked to estimate for the provision and installation of the new machinery. The Shipping Board is reported to view the scheme with considerable favour.

The Boilermakers' Dispute.

Although there are still no signs of the boilermakers' dispute reaching an end, hopes in that direction arose this week by the announcement that the boilermakers' Executive had decided to meet the Federation of Engineering and Shipbuilding Trades at that body's request, with a view to discussing the possibility of arriving at an honourable settlement of the overtime and night shift dispute. The conference took place at York on Wednesday. No agreement, however, was reached, and the discussion was adjourned indefinitely. It may be recalled that the Federation accepted the agreement, but that the Boilermakers' Society took an independent course, declined to be bound by or take part in the Federation's ballot, and was as a result expelled from membership of that body. The disastrous nature of this dispute may be judged from the fact that one idle boilermaker is estimated to throw sixteen other workers out of employment. On the Clyde alone there are now 14,500 shipyard workers idle, and several of the builders are considering the entire closing down of their yards.

Clydebridge Steel Works.

No. I.

The Clydebridge Steel Works of David Colville and Sons, Limited, are equipped for an output of over 5000 tons of plates per week, and, so far as the new portion of the works is concerned, represent the latest methods in steel works practice. Before giving a detailed account of the new plant, which we propose to do in what follows, reference may be made to the origin of the Clydebridge Works and the development which has taken place during the last ten years.

The Old Works.

Situated on the banks of the river Clyde at Cambuslang, three miles from Glasgow, the Clydebridge Steel Works were opened in 1888 by the Clydebridge Steel Company, Limited. In Fig. 1 we reproduce a block plan showing both the old and new works, from which it will be seen that the older portion was constructed directly alongside the river. The original plant comprised six acid-lined open-hearth furnaces and a battery of gas producers, the nominal capacity of each furnace being 25 tons. Ingot reheating furnaces and a 28½in. slab cogging mill were installed, and the further plant included a geared slab shearing machine, slab reheating furnaces, and two reversing plate mills, with the necessary equipment of plate shears and other auxiliary plant. All the machinery was steam-driven by non-condensing engines, the steam being raised in a battery of Lancashire boilers. In the year 1907 a further addition of two 50-ton acid-lined open-hearth furnaces was made, and another heavy plate mill with rolls 42in. in diameter by 13ft. 6in. long was installed. The plant continued working with steam drives for some time, but after the formation of the Clyde Valley Electrical Power Company, Limited, and the opening of the Motherwell supply station, current was taken from that company and a number of the cranes and slab charging machines were altered for electric driving. In the years immediately preceding the war there was a serious depression in the Scottish steel trade, and for some time the works were completely shut down. In 1914 they were still closed, but with the outbreak of hostilities there was a sudden demand for steel billets capable of rapid conversion into high explosive shells of various sizes. Several Scottish steel makers were approached by the Government authorities with a view to meeting this urgent demand, and at the urgent request of the Government David Colville and Sons, Limited, purchased the Clydebridge Works and made the necessary alterations for producing billets of the desired sizes. This decision was reached early in 1915 and work was then immediately begun on the slab cogging mill, which was converted into a billet mill in which shell billets could be rolled. At the same time an additional 50-ton open-hearth furnace was built. The shops were also equipped with batteries of hack saws and shell billet breaking machines. In order to meet the new demands for power a mixed pressure steam turbine was installed to make use of the exhaust steam from the cogging mill and from the other steam engines in connection with the plant. This additional equipment considerably increased the capacity of the works, and during the remainder of the war period about 150,000 tons of high explosive shell billets were produced.

The continued sinking of allied ships by enemy submarines and the necessity for quickly replacing them by standard ships caused a further reorganisation of the works in another direction. The firm was again approached by the Government with a view to augmenting the supply of steel plates, and the question was then considered as to whether the idle plate mills at the Clydebridge Works could be effectively used for that purpose.

In consequence of the position thus brought about it was then decided to proceed with a new melting shop and cogging mill, which work was started early in 1917. The illustrations which we reproduce on page 228 show the progress which was made during 1917 and the following year. While operations were in their initial stages in 1916, first Mr. David, and within the next two months, Mr. Archibald Colville, the managing directors of the company, died, and the task of carrying out the scheme to a successful completion devolved upon Mr. John Craig, the present chairman of the company, who commenced service with Messrs. Colville in 1888 and has since been engaged constantly with them.

Fig. 1, already referred to, shows the relation of the new melting shop to the older part of the works. The extension comprised five basic-lined open-hearth furnaces, each of 60 tons nominal capacity, along with the necessary gas producers and other auxiliary plant. A slab cogging mill with steam hydraulic slab shears and two ingot reheating furnaces were also installed. The part of the plant we have just referred to was started up in 1917, and up to the Armistice about 70,000 tons of steel plates were made.

With the ending of the war the demand for shell billets and certain other war material ceased, and it was then decided to install a new three-high plate mill in order that the output of the two melting shops might be fully used. The new plate mill was finally completed and the rolling of plates proceeded with in February of this year.

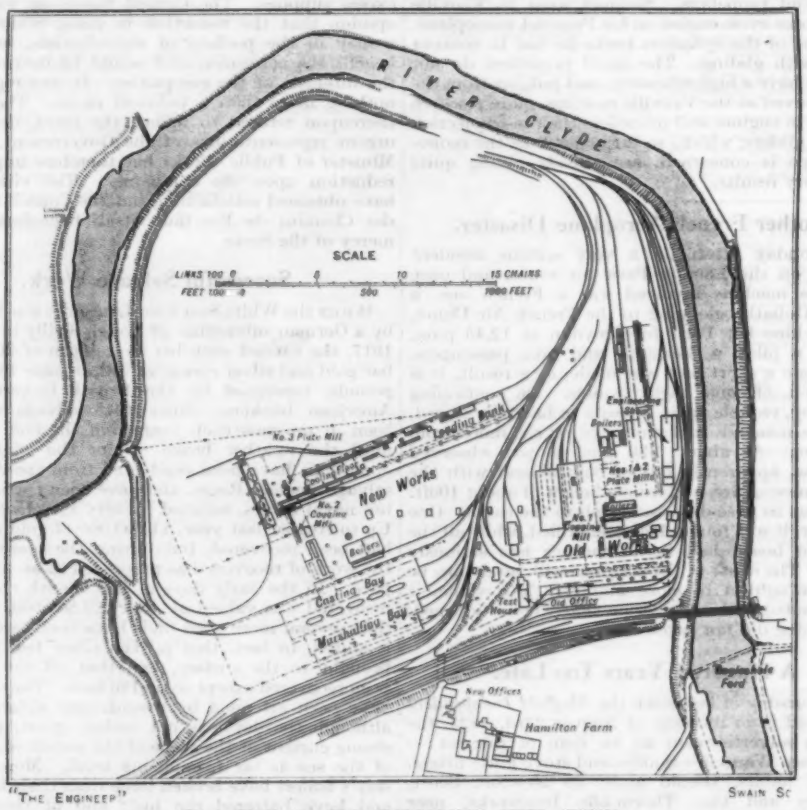


FIG. 1—PLAN OF THE CLYDEBRIDGE STEEL WORKS

The New Works.

Having briefly described the history and development of the works, we are now in a position to deal more especially with the equipment of the new works, a general arrangement plan of which is shown in the drawing we reproduce on the opposite page.

Melting Shop.—As will be noted from the plan and elevation just referred to and also from the illustrations on page 219, the melting shop consists of three main bays with a lean-to at one side, which latter portion of the building accommodates the gas producers and has an overall length of 430ft. The first span is that over the marshalling and stock bay, which is 71ft. wide and 470ft. long. Adjoining it is the 70ft. span of the furnace bay and the 66ft. span of the casting bay, the length of each of these shops being 560ft. The structural work of these buildings was carried out by Sir William Arrol and Co., Limited, and on April 2nd, 1918, the first furnace was put into operation.

The open-hearth furnaces, of which there are five, each have a nominal capacity of 60 tons.

The general appearance of these furnaces, as seen from the charging platform, is shown in one upper view reproduced in to-day's Supplement. They are each 32ft. long between the blocks and 13ft. wide between the walls, while the air regenerators have 2940 and the gas regenerators 1960 cubic feet of chequer work. There are two air uptakes, each 3ft. by 2ft. 6in., while the single gas uptake is slightly larger, being 3ft. by 3ft. 7in. Maerz type ports are fitted in the furnace blocks and the gas reversing valve is of the water-sealed drum type with an air reversing valve of the ordinary butterfly pattern. Each furnace is provided with a chimney 140ft. in height above the working platform, with a shaft 6ft. 3in. in diameter inside the brick lining. The furnaces are served by two revolving open-hearth charging machines, of the overhead type, made by Babcock and Wilcox, Limited. These machines are so arranged that the charging boxes may be taken up from the marshalling and stock bay and their contents delivered to the furnaces. This bay is served by two 10-ton magnet cranes made by John Grieve and Co., which lift the scrap and pig iron either from the stock piles or straight from the wagons and deliver it into the charging machine boxes. The other side of the furnaces, as seen from the casting bay, is also shown in the Supplement, and the view given serves to illustrate one of the hot

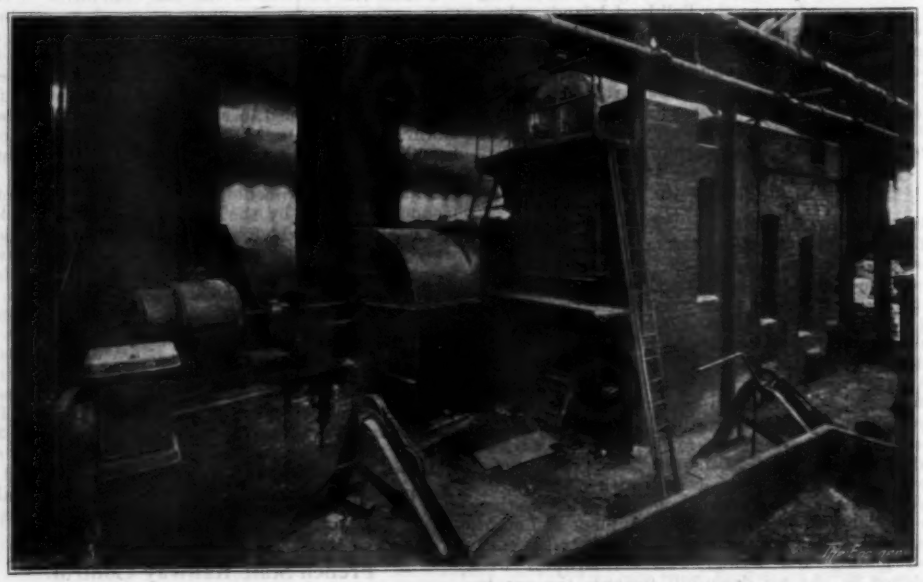
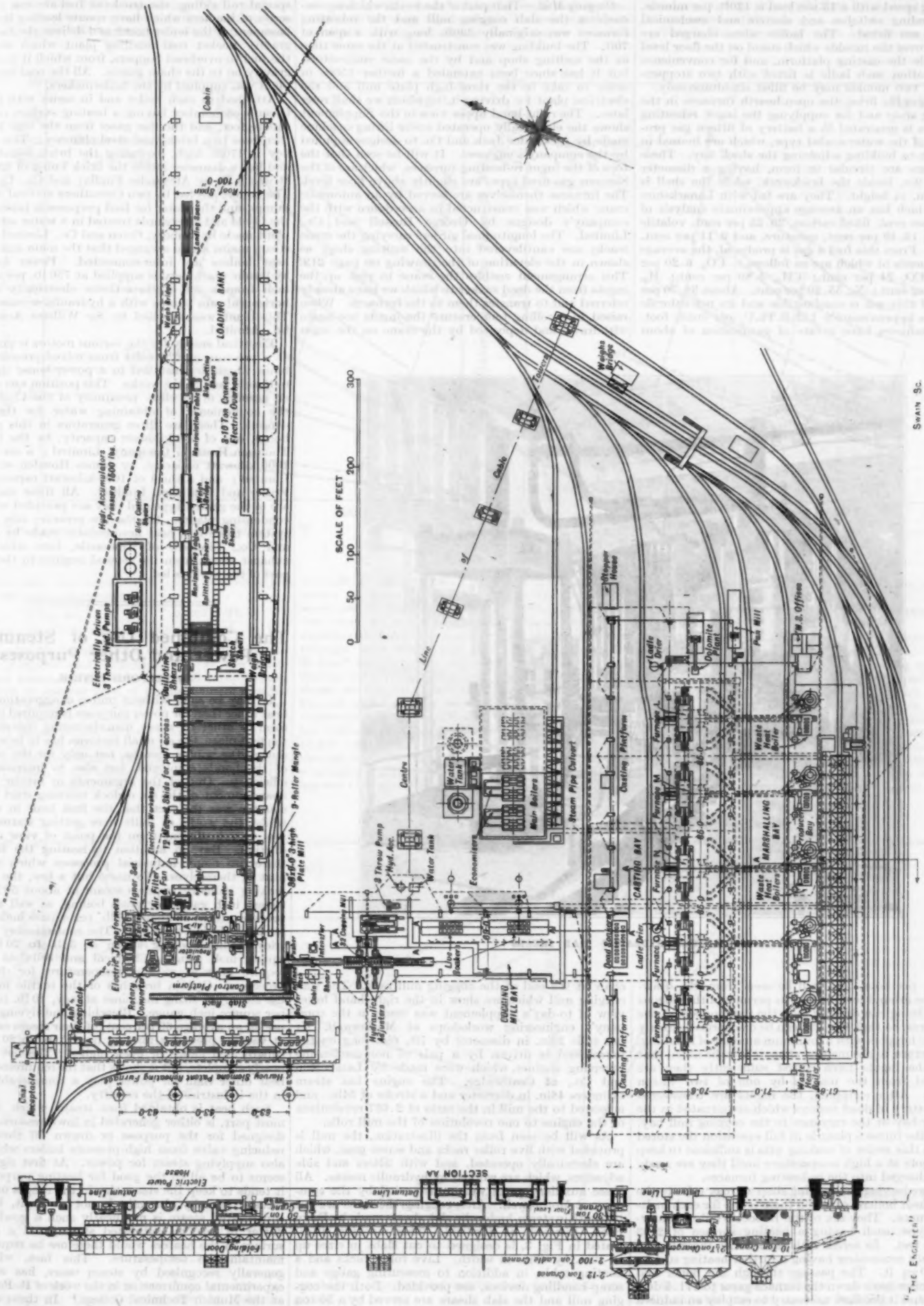


FIG. 2—WASTE HEAT BOILER AND INDUCED DRAUGHT FAN

metal ladles, and the lower part of one of two special 100-ton overhead cranes supplied by Sir William Arrol and Co., Limited, for transporting the ladles from the furnaces to the ingot moulds.

This crane is of the two-crab type, and the motions of the main and auxiliary hoisting, main and auxiliary traversing, and travelling are each operated by independent motors. The crane has a span of 60ft. from centre to centre of the track rails and a height of 47ft. 6in. from the floor to the rail level. The motors

SECTION AND PLAN OF NEW PORTION OF CLYDEBRIDGE STEEL WORKS



THE ENGINEER

are supplied with 220-volt current and are designed to give a main hoisting speed of 7ft. per minute in slow gear with a 100-ton lift, and double that speed in fast gear with a 50 tons lift. The main traversing speed under full load is 75ft. per minute and the travelling speed 120ft. per minute. The auxiliary hoisting speed with a 15-ton load is 120ft. per minute. Overwinding switches and electric and mechanical brakes are fitted. The ladles when charged are carried over the moulds which stand on the floor level alongside the casting platform, and for convenience of operation each ladle is fitted with two stoppers so that two moulds may be filled simultaneously.

The gas for firing the open-hearth furnaces in the melting shop and for supplying the ingot reheating furnaces is generated in a battery of fifteen gas producers of the water-sealed type, which are housed in the lean-to building adjoining the stock bay. These producers are circular in form, having a diameter of 9ft. 9in. inside the brickwork, while the shell is 12ft. 5in. in height. They are fed with Lanarkshire coal, which has an average approximate analysis of 46.15 per cent. fixed carbon, 30.25 per cent. volatile matter, 12.49 per cent. moisture, and 9.11 per cent. of ash. From this fuel a gas is produced, the average constituents of which are as follows:—CO_2, 6.20 per cent.; CO, 24 per cent.; CH_4, 3.80 per cent.; H_2, 10.70 per cent.; N_2, 55.30 per cent. About 38.50 per cent. of this gas is combustible and its net calorific value is approximately 152 B.Th.U. per cubic foot. The producers have a rate of gasification of about 14 cwt. per hour. As will be seen from the drawings, the ground level is such as permits of the wagons of fuel being run directly over the fuel hoppers of the producers, so that the fuel can be discharged directly into the hoppers with a minimum amount of handling.

To return to the melting shop, it is to be noted that after the ingots have cooled sufficiently they are stripped from the moulds by one of two 12-ton cranes. After stripping, the ingots are transferred to a battery of dead soakers which are situated in the casting bay at the entrance to the cogging mill bay. When the furnace plant is in full operation the stored heat in this series of soaking pits is sufficient to keep the ingots at a high temperature until they are ready to be charged into the re-heating furnaces.

Before leaving the melting shop we may refer to the waste heat boilers, of which there is one for each melting furnace. They are of the Babcock-Wilcox water-tube type, each having a heating surface of 2193 square feet. In series with each boiler there is also a Green's economiser having a further heating surface of 1200 sq. ft. The passage through the boiler and economiser cools down the furnace gases to 171.5 deg. Cent., and it becomes necessary to employ an induced draught fan in order to maintain the necessary draught at the furnaces. The fans, by Keith and Blackman, are of the multi-vane type, having impellers 50in. in diameter. Those of our readers who are desirous of obtaining further particulars of these waste heat boilers may consult a paper on this subject read by Mr. Thomas B. Mackenzie before the autumn meeting of the Iron and Steel Institute in 1918. A *résumé* of this paper was given in THE ENGINEER of September 27th of that year. The type of boiler in use at Clydebridge, which is also referred to in the paper we have mentioned as No. III., is illustrated in Fig. 2, which view also shows the induced draught fan and the motor driving it.

Cogging Mill.—That part of the works which accommodates the slab cogging mill and the reheating furnaces was originally 390ft. long with a span of 70ft. The building was constructed at the same time as the melting shop and by the same contractors, but it has since been extended a further 150ft. in order to take in the three-high plate mill and the electrical plant for driving it, to which we shall refer later. The right-hand upper view in the Supplement shows the electrically operated cover lifting machine made by Alexander Jack and Co. to designs supplied by the company's engineer. It will be seen that the tops of the ingot re-heating furnaces, which are of the Siemens gas-fired type, are slightly above floor level. The furnaces themselves are served by an automatic crane which was constructed in accordance with the company's designs by George Russell and Co., Limited. The longitudinal girders carrying the crane tracks are cantilevered into the melting shop, as shown in the elevation of the drawing on page 219. This arrangement enables the crane to pick up the ingots from the dead soaker to which we have already referred and to transfer them to the furnaces. When raised to a rolling temperature the ingots are again withdrawn and deposited by the crane on the ingot chair at the end of the cogging mill rack. The slab cogging mill which we show in the right-hand lower view of to-day's Supplement was made in the company's engineering workshops at Motherwell. It has rolls 33in. in diameter by 7ft. 6in. long on the barrel and is driven by a pair of non-condensing reversing engines, which were made by Lamberton and Co., of Coatbridge. The engine has steam cylinders 48in. in diameter and a stroke of 54in., and is geared to the mill in the ratio of 2.667 revolutions of the engine to one revolution of the mill rolls.

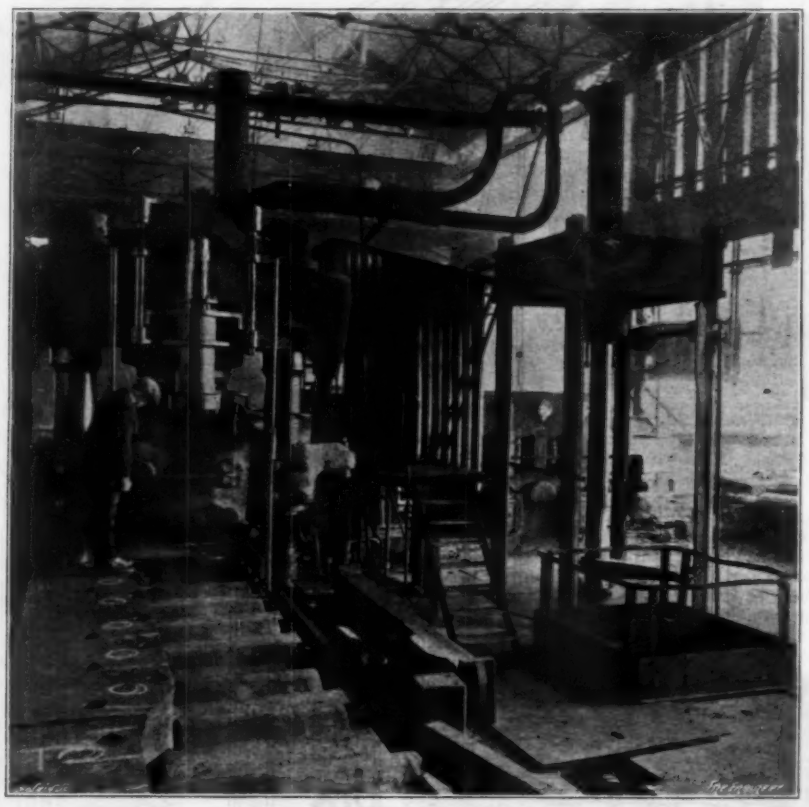


FIG. 3—STEAM-HYDRAULIC SLAB SHEARS

As will be seen from the illustration, the mill is provided with live roller racks and screw gear, which are electrically operated, and with tilters and side adjusters, which are worked by hydraulic means. All these auxiliary parts were constructed by the company at Motherwell. After cogging, the slabs are cut to length in steam-hydraulic slab shears made by Davy Bros., Limited, of Sheffield. This machine, illustrated in Fig. 3, is designed to cut slabs in sizes up to 10in. by 40in. in width. Live roller racks and a floating table, in addition to measuring gauge and scrap-handling devices, are provided. Both the cogging mill and the slab shears are served by a 30-ton overhead crane made by Marshall, Fleming and Co., Limited.

Main Boiler Plant.—Steam for the engine driving the slab cogging mill and for the steam intensifier at the slab shears is generated in four Babcock-Wilcox water-tube boilers of the double-drum land type, which are arranged in two batteries in a boiler-house adjoining the casting and cogging mill bays. Each boiler has a heating surface of 6182 square feet and is fitted with a chain grate stoker and an integral superheater. The working pressure is 150 lb. per square inch and the temperature of the steam is raised by the superheaters to give a degree of superheat of 100 deg. to 120 deg. Fah. By means of a special rail siding, the trucks of fuel are run over a series of bunkers which have spouts leading into the basement of the boiler-house and deliver the fuel to a gravity bucket coal-handling plant which elevates the fuel to overhead hoppers, from which it is fed by gravity on to the chain grates. All the coal-handling plant was supplied by the boilermakers.

Attached to each boiler and in series with it is a Green's economiser having a heating surface of 2000 square feet, and the flue gases from the four boilers then pass to a brick-lined steel chimney. This chimney is 170ft. high, excluding the brick foundation, and has a diameter inside the brick lining of 9ft. 2in. It was built by Alexander Findlay and Co., Limited. The boilers are fed by two Carruthers vertical duplex pumps, and the water for feed purposes is taken from the Clyde and afterwards treated in a water softening plant made by Rubery, Owen and Co., Limited. The steam mains are so arranged that the main and waste heat boilers are inter-connected. Power for the hydraulic machinery is supplied at 750 lb. per square inch from a set of three-throw electrically driven horizontal ram pumps with a hydraulic accumulator. This plant was supplied by Sir William Arrol and Co., Limited.

Electrical energy for the various motors is provided at a pressure of 220 volts from mixed-pressure turbines which are installed in a power-house situated in the old part of the works. This position was chosen on account of its close proximity of the Clyde and the convenience of obtaining water for the condensers. There are three generators in this power-house, one of 500-kilowatt capacity, by the British Thomson-Houston Company, Limited; a second of 1000-kilowatt capacity, by James Howden and Co., Limited; and a third of 1000-kilowatt capacity, by Fraser and Chalmers, Limited. All these machines are of the geared type and they are provided with jet condensing plants. On the low-pressure side of the system there is a heat accumulator made by Gedye and Co., Limited, of Newcastle, into which the exhaust steam from the several engines in the older part of the works is led.

The Combined Use of Steam for Power and Other Purposes.

By TELFORD PETRIE.

IT may be said, without undue exaggeration, that heat other than for power purposes is required in some form or other by every manufacturing concern. In the first place, the air of all factories has to be warmed during the winter months, not only for the comfort of the hands employed, but also to increase their efficiency. One of the arguments in favour of the abandonment of the six o'clock morning start in this country was the fact that the first hour in winter, whilst the works or mills were getting warmed up, was very inefficient from the point of view of production. But, in addition to heating the factory, there are many industrial processes which require heat in themselves. To name but a few, the paper-making industry requires steam at about 50 lb. per square inch gauge for grass boiling, as well as low-pressure steam at about 15 lb. per square inch gauge for their drying cylinders. The confectionery industries require cooking steam at 5 lb. to 20 lb. per square inch gauge. Chemical and celluloid works require heat at various temperatures for different processes. Certain branches of the textile industry use steam for sizing machines at, say, 10 lb. to 15 lb. per square inch gauge. Bleaching and dyeing works use on an average 60 per cent. of their steam capacity at various pressures, ranging from 5 lb. to 20 lb. per square inch gauge or even higher. The list is not nearly complete, but it shows that the requirements for heat other than for power play a considerable part in the industries of the country.

Such heat is obtained from steam, which, for the most part, is either generated in low-pressure boilers designed for the purpose or drawn off through a reducing valve from high-pressure boilers which are also supplying steam for power. At first sight this seems to be all to the good for heating purposes, as it tends to keep the steam dry in the ranges or apparatus. Actually the gain is not so great, because superheated steam is not nearly such a good transmitter of heat as saturated steam, and a greater surface in the heaters would therefore be required to maintain the temperature. This fact, which is generally recognised by steam users, has received experimental confirmation in the work of R. Poensgen at the Munich Technical College.[1] In these experiments superheated steam was passed at velocities varying from 2.5 m. to 15 m. per second (8.2ft. to 49.2ft. per second) through Mannesmann weldless steel tubes either 95.7 mm. or 39.4 mm. inside

[1] R. Poensgen. *Forschungsarbeiten*, Vols. 191 and 192, Berlin, 1917. "Ueber die Wärmeübertragung von strömenden überhitztem Wasserdampf an Rohrwandungen und von Heizgasen an Wasserdampf." Published for the V.D.I. by J. Springer.

diameters and 108 mm. and 45 mm. outside diameters. The length of the tube in each case was 3.5 m. (11½ft.). The steam pressures were varied from 1 to 9 atmospheres (14.7 lb. to 132 lb. per square inch abs.) and the steam temperature from saturation to 350 deg. Cent. (662 deg. Fah.). The mean of both steam and tube wall temperatures were computed from the temperature gradient as measured at seven points along the tube and the conductivity from steam to tube wall calculated in kg. cal. per hour per deg. Cent. per square metre.

$$\left(\begin{array}{c}\text{1 kg. cal.}\\ \text{hour, deg. Cent., sq. m.}\end{array} = \begin{array}{c}\text{0.205 B.Th.U.}\\ \text{hour, deg. Fah., sq. ft.}\end{array}\right)$$

The results are tabulated for different wall-temperatures, pressures and velocities, but as the ratios between steam temperatures and wall temperatures are given in another part of the paper it is possible to deduce direct the conductivity effect of steam for varying degrees of superheat.

Fig. 1 shows curves derived from Poensgen's test results for 2.5 m. per second (8.2ft. per second) and Fig. 2 similar curves for 15 m. per second (49.2ft. per second), which is the highest velocity reached in the experiments. Intermediate velocities and therefore intermediate wall temperatures can readily be obtained by the linear velocity law of Osborne Reynolds.

In both cases the steam temperatures required to maintain these wall temperatures have been superimposed in dotted lines. Such temperatures may be read off horizontally from any chosen wall temperature. For instance, a wall temperature of 130 deg. Cent. and 3 atmospheres in Fig. 1 is maintained by a steam temperature of 158 deg. Cent. at a heat transmission of 25 units. The similarity between these steam curves and curves showing the more recent determination of the mean specific heats of superheated steam[3] should be noted.

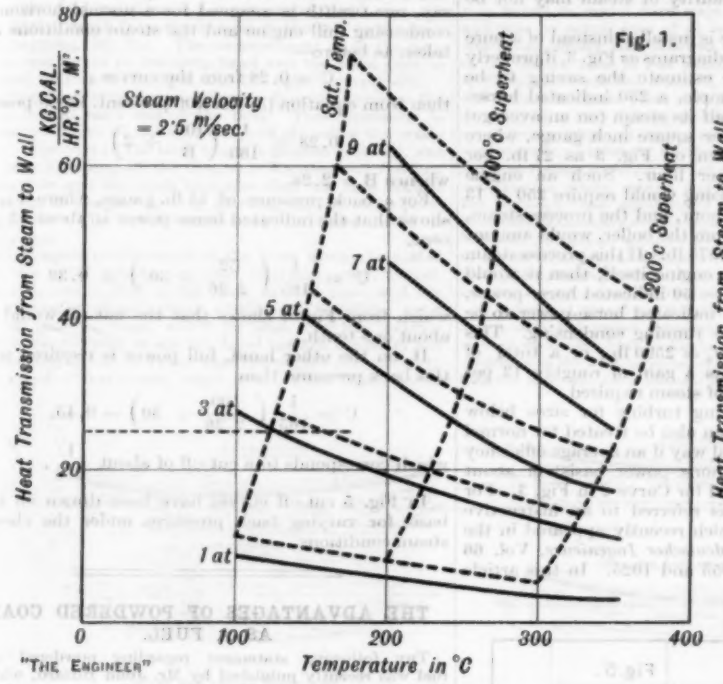
On the other hand, the heat transmission from condensing steam to tube walls is at least twenty times as great as the above values for superheated steam and may be very much more. It does not depend so much on the velocity of the steam or its initial pressure as on how much moisture there is in the steam to start with, how rapidly the condensed steam can be removed from the heating surface, and how much air is contained in the steam. Numerous experiments have been made on the heat transmission through tube walls with condensing steam. R. Mollier[3] shows how such results may be used to deduce the corresponding heat transmission from the steam to the tube wall and considers that 10,000 kg. cal. per hour per deg. Cent. per square metre represents a fair average figure. It varies, apparently, for different test conditions from about 7000 to 13,000 continental units. For heat transmission through the tube wall reference may also be made to a valuable contribution by J. G. Hudson[4] on "Heating and Concentrating Liquids by Steam," in which a number of experimental results and deductions are given.

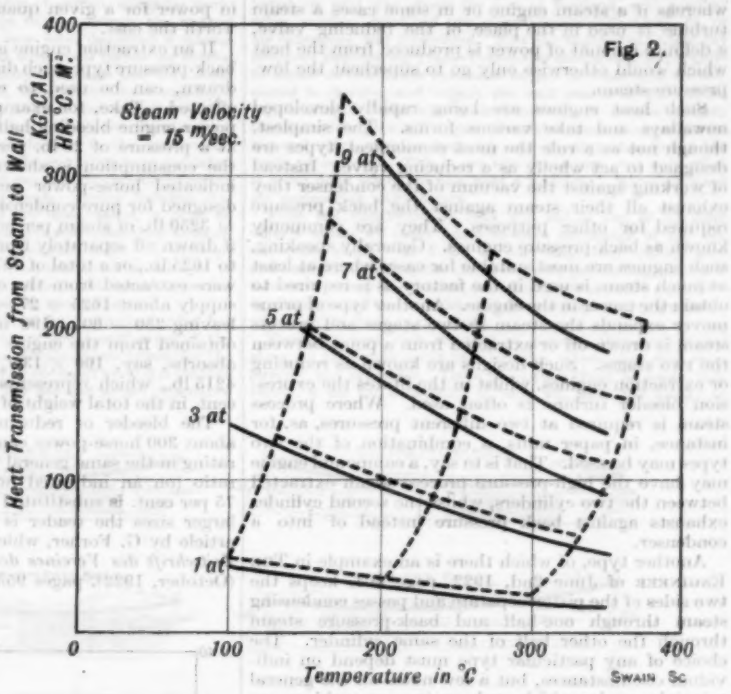
If the heat transmission is much more rapid between a medium, such as condensing steam, and a heating surface than between that surface and its second medium, the temperature of the surface will be maintained at approximately that of the heating medium, and as the conductivity between tube wall and air is very low—about 10 continental units—improvements in steam heating apparatus can be looked for more on the outside of the tube walls than by raising the steam temperature within.

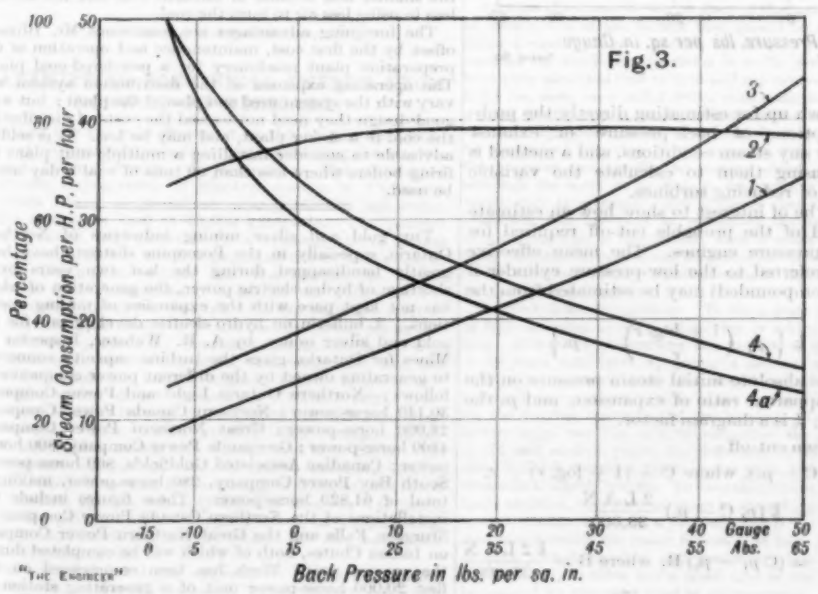
This is the converse of what happens in a steam boiler where the heat transfer is poor on the gas side of the flue compared to the water side of the heating surface, and consequently the flues remain comparatively cool.

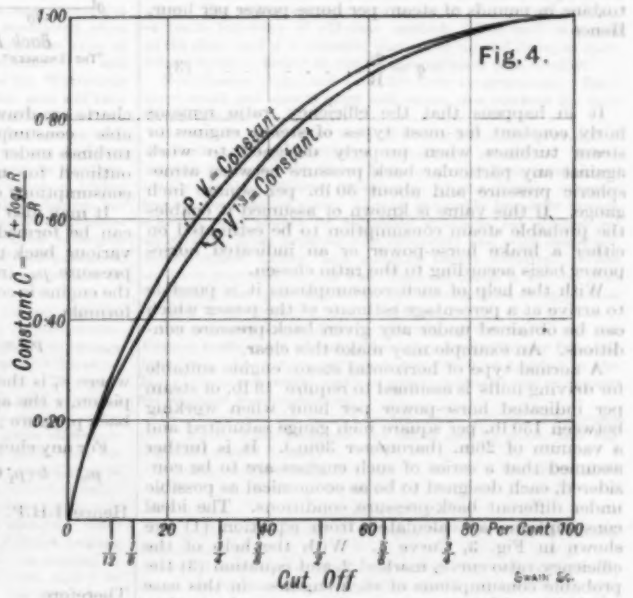
Considerations of such experimental results go a long way to explain the curious fact which once puzzled Rankine[5] that high-pressure steam escaping through a small orifice, and therefore superheated, will not burn the hand, whilst low-pressure steam, although at a lower temperature, will inflict serious injury to the skin. It shows that there was more truth behind Jerome K. Jerome's famous story of the boiling kettle than perhaps he himself suspected.

Such low-pressure steam is very frequently used in this country in pipes and radiators for heating buildings. Electricity, as a general rule, is too expensive for this purpose, whilst hot water pipes are only really suitable for such smaller buildings as laboratories, offices or domestic houses. The chief successful competitor of steam heating in bulk is hot air, which is passed through air heaters placed between the exhaust of the prime mover and its condenser and circulated by means of specially provided air ducts built into the walls. This method is more readily









[3] See, for instance, "Modern Practice in Heat Engines," by Telford Petrie, 1922, page 5.

[3] "Ueber Wärmedurchgang und die bezuglichen Versuchsergebnisse," *Zeitschrift des Vereines deutscher Ingenieure*, Vol. 41 (1897), p. 187.

[4] "Heating and Concentrating Liquids by Steam," THE ENGINEER, vol. lxix., 1890, p. 291, &c.

[5] "Life of Lord Kelvin," by Silvanus P. Thompson (1910), Vol. I., p. 278.

applicable to new buildings and requires special plant for its propagation. It is at present more common in the United States than in this country.

Low-pressure steam is also all that is required for most works processes, whilst a few require a certain amount of pressure in addition to what is wanted to maintain circulation. Whatever the process-pressure may be, it must be wasteful and expensive to draw the steam from a high-pressure boiler through reducing valves. Such valves do no useful work beyond maintaining the initial total heat of the steam, whereas if a steam engine or in some cases a steam turbine is used in the place of the reducing valve, a definite amount of power is produced from the heat which would otherwise only go to superheat the low-pressure steam.

Such heat engines are being rapidly developed nowadays and take various forms. The simplest, though not as a rule the most economical, types are designed to act wholly as a reducing valve. Instead of working against the vacuum of the condenser they exhaust all their steam against the back pressure required for other purposes. They are commonly known as back-pressure engines. Generally speaking, such engines are most suitable for cases where at least as much steam is used in the factory as is required to obtain the power in the engine. Another type of prime mover expands the steam in two stages and process steam is drawn off or extracted from a point between the two stages. Such designs are known as reducing or extraction engines, whilst in the States the expression bleeder turbine is often used. Where process steam is required at two different pressures, as, for instance, in paper mills, a combination of the two types may be used. That is to say, a compound engine may have the high-pressure process steam extracted between the two cylinders, whilst the second cylinder exhausts against back pressure instead of into a condenser.

Another type, of which there is an example in THE ENGINEER of June 2nd, 1922, page 604, keeps the two sides of the piston separate and passes condensing steam through one-half and back-pressure steam through the other half of the same cylinder. The choice of any particular type must depend on individual circumstances, but a few notes on the general principles under which such engines or turbines are constrained to work may be of interest.

If Q is the total steam consumption per hour in pounds and I the adiabatic heat drop in B.Th.U. according to the Rankine cycle, then the ideal horse-power developed per hour

$$\text{H.P.} = \frac{778\,\text{I}\,\text{Q}}{33{,}000 \times 60} = \frac{\text{I}\,\text{Q}}{2546}$$

and the ideal steam consumption (q_i)

$$q_i = \frac{\text{Q}}{\text{H.P.}} = \frac{2546}{\text{I}} \text{ lb. per horse-power per hour} \quad . \quad . \quad (1)$$

The coefficient of performance or efficiency ratio (R) may be written

$$\text{R} = \frac{q_i}{q} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where q is the actual consumption of the engine or turbine in pounds of steam per horse-power per hour. Hence

$$q = \frac{q_i}{\text{R}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

It so happens that the efficiency ratio remains fairly constant for most types of steam engines or steam turbines when properly designed to work against any particular back pressure between atmospheric pressure and about 50 lb. per square inch gauge. If this value is known or assumed it enables the probable steam consumption to be estimated on either a brake horse-power or an indicated horse-power basis according to the ratio chosen.

With the help of such consumptions it is possible to arrive at a percentage estimate of the power which can be obtained under any given back-pressure conditions. An example may make this clear.

A normal type of horizontal steam engine suitable for driving mills is assumed to require 13 lb. of steam per indicated horse-power per hour when working between 150 lb. per square inch gauge saturated and a vacuum of 26in. (barometer 30in.). It is further assumed that a series of such engines are to be considered, each designed to be as economical as possible under different back-pressure conditions. The ideal consumptions as calculated from equation (1) are shown in Fig. 3, Curve 1. With the help of the efficiency-ratio curve, marked 2, and equation (3) the probable consumptions of such engines—in this case per indicated horse-power per hour—are obtained in Curve 3. For a given total quantity of steam per hour (Q) the percentage indicated power then follows from the relation

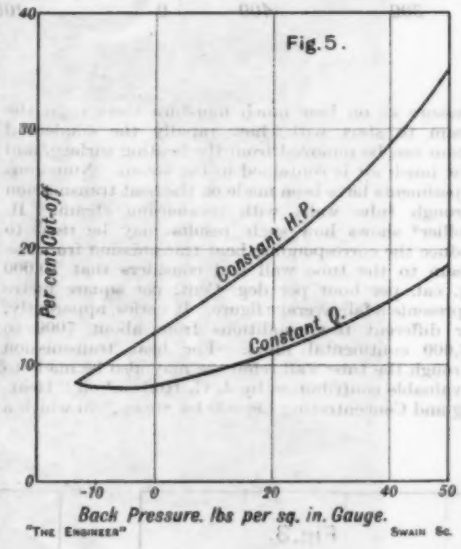
$$\text{Per cent. I.H.P.} = \frac{\text{Q}}{q} \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where the indicated horse-power for a vacuum of 26in. is taken as 100 per cent. This is shown on the same figure in Curve 4, whilst Curve 4a shows the corresponding relation for the ideal consumption (q_i). It is a simple matter to extend such curves to any desired steam conditions or apply them on a brake horse-power or kilowatt basis to both steam engines and steam turbines according to the data in the possession of the designer.

The first thing to notice is the proportion of extra power available if the back pressure is kept as low as possible. Too many heating installations in existence at present have not been considered sufficiently in this light, and contain far more resistance to flow than is really necessary. It is a question whether, by installing new pipe lines and eliminating sharp bends as much as possible and so forth, the resulting increase in power for a given quantity of steam may not be worth the cost.

If an extraction engine is installed instead of a pure back-pressure type, such diagrams as Fig. 3, if properly drawn, can be used to estimate the saving to be effected. Take, for example, a 250 indicated horse-power engine bleeding half its steam (on an average) at a pressure of 20 lb. per square inch gauge, where the consumption is shown on Fig. 3 as 27 lb. per indicated horse-power per hour. Such an engine designed for pure condensing would require $250 \times 13 = 3250$ lb. of steam per hour, and the process steam, if drawn off separately from the boiler, would amount to 1625 lb., or a total of 4875 lb. If this process steam were extracted from the engine itself, then it would supply about $1625 \div 27 = 60$ indicated horse-power, leaving $250 - 60 = 190$ indicated horse-power to be obtained from the engine running condensing. This absorbs, say, $190 \times 13^1/_2 = 2590$ lb., or a total of 4215 lb., which represents a gain of roughly 13 per cent. in the total weight of steam required.

The bleeder or reducing turbine for sizes below about 300 horse-power can also be treated for normal rating in the same general way if an average efficiency ratio (on an indicated horse-power basis) of about 75 per cent. is substituted for Curve 2 in Fig. 3. For larger sizes the reader is referred to an instructive article by G. Forner, which recently appeared in the *Zeitschrift des Vereines deutscher Ingenieure*, Vol. 66 (October, 1922), pages 955 and 1025. In this article



charts are drawn up for estimating directly the probable consumptions of back-pressure or exhaust turbines under any steam conditions, and a method is outlined for using them to calculate the variable consumptions of reducing turbines.

It may also be of interest to show how an estimate can be formed of the probable cut-off required for various back-pressure engines. The mean effective pressure p_m (referred to the low-pressure cylinder if the engine is compounded) may be estimated from the formula

$$p_m = k \left\{ p_1 \left(\frac{1 + \log_e r}{r} \right) - p_b \right\}$$

where p_1 is the absolute initial steam pressure on the piston, r the apparent ratio of expansion, and p_b the back pressure; k is a diagram factor.

For any chosen cut-off

$$p_m = k\,(p_1\,\text{C} - p_b), \text{ where } \text{C} = (1 + \log_e r) \div r.$$

$$\text{Hence I.H.P.} = k\,(p_1\,\text{C} - p_b)\,\frac{2\,\text{L}\,\text{A}\,\text{N}}{33{,}000}$$

$$= (\text{C}\,p_1 - p_b)\,\text{B}, \text{ where } \text{B} = \frac{k\,2\,\text{L}\,\text{A}\,\text{N}}{33{,}000}$$

Therefore

$$\text{C}\,p_1 = \frac{\text{I.H.P.}}{\text{B}} + p_b = \text{a constant for any particular engine, and}$$

$$\text{C} = \frac{1}{p_1}\left(\frac{\text{I.H.P.}}{\text{B}} + p_b\right) \quad . \quad . \quad . \quad . \quad . \quad (5)$$

If it is assumed that the expansion curve follows the law $\text{P}\,\text{V}^n$ = constant, then the mean effective pressure (p_m) may be deduced from the formula

$$p_m = k \left\{ \frac{p_1}{n-1} \left(\frac{n}{r} - \frac{1}{r^n} \right) - p_b \right\}$$

In which case

$$\text{C} = \frac{1}{n-1}\left(\frac{n}{r} - \frac{1}{r^n}\right).$$

Fig. 4 gives curves connecting the apparent cut-off with the valve C for the two extreme cases when the expansion curves of the steam follows the laws $\text{P}\,\text{V}$ = constant and $\text{P}\,\text{V}^{1.3}$ = constant. The actual cut-off should lie somewhere between these two graphs, depending on the steam conditions and other factors.

If a cut-off referred to the low-pressure cylinder of, say, one-twelfth is assumed for a normal horizontal condensing mill engine and the steam conditions are taken as before—

$$\text{C} = 0.28 \text{ from the curves;}$$

then from equation (5) (for 100 per cent. horse-power)

$$0.28 = \frac{1}{165}\left(\frac{100}{\text{B}} + 2\right)$$

whence $\text{B} = 2.26$.

For a back pressure of 15 lb. gauge, where Fig. 3 shows that the indicated horse-power is about 52 per cent.

$$\text{C} = \frac{1}{165}\left(\frac{52}{2.26} + 30\right) = 0.32$$

which from Fig. 4 shows that the cut-off would be about one-tenth.

If, on the other hand, full power is required with this back pressure, then

$$\text{C} = \frac{1}{165}\left(\frac{100}{2.26} + 30\right) = 0.45,$$

which corresponds to a cut-off of about $\frac{1}{5.6}$.

In Fig. 5 cut-off curves have been drawn on this basis for varying back pressures under the chosen steam conditions.

THE ADVANTAGES OF POWDERED COAL AS A FUEL.

THE following statement regarding powdered coal fuel was recently published by Mr. John Blizard, who is Fuel Engineer to the United States Department of the Interior:—A modern, well-designed, multiple-unit, powdered-coal fired boiler plant is operated more easily than a modern stoker plant for the following reasons:—(1) There is but little coal in the furnace at any time, which makes it possible to increase or decrease the rate of combustion very quickly by changing the rate of supply of coal and air; (2) practically any coal may be burned completely with a small excess of air and without making any but the simplest changes in feeding the coal and air; (3) no mechanism is exposed to the high furnace temperature, and the cost of installation, maintenance and operation of the boiler-firing machinery will be less than in a stoker plant; (4) very little labour is required to operate the boilers; one man can operate five large boilers, and he has none of the arduous work involved in caring for the fire bed of a stoker; (5) the ash, if the furnace be properly designed, gives less trouble and costs less to remove than the ash in stoker plants; (6) the powdered-coal fired furnace is quickly and simply adapted for burning gaseous or liquid fuels should they be available at a cheap price; and (7) in every-day running the efficiency will be higher than with stoker-fired boilers, through the smaller loss because of unburnt fuel and the smaller loss in using less air to burn the coal.

The foregoing advantages are, continues Mr. Blizard, offset by the first cost, maintenance and operation of the preparation plant machinery for a powdered-coal plant. The operating expenses of the distribution system will vary with the system used and plan of the plant; but with good design they need not exceed the costs of distributing the coal in a stoker plant, and may be less. It is seldom advisable to consider installing a multiple-unit plant for firing boilers where less than 80 tons of coal a day are to be used.

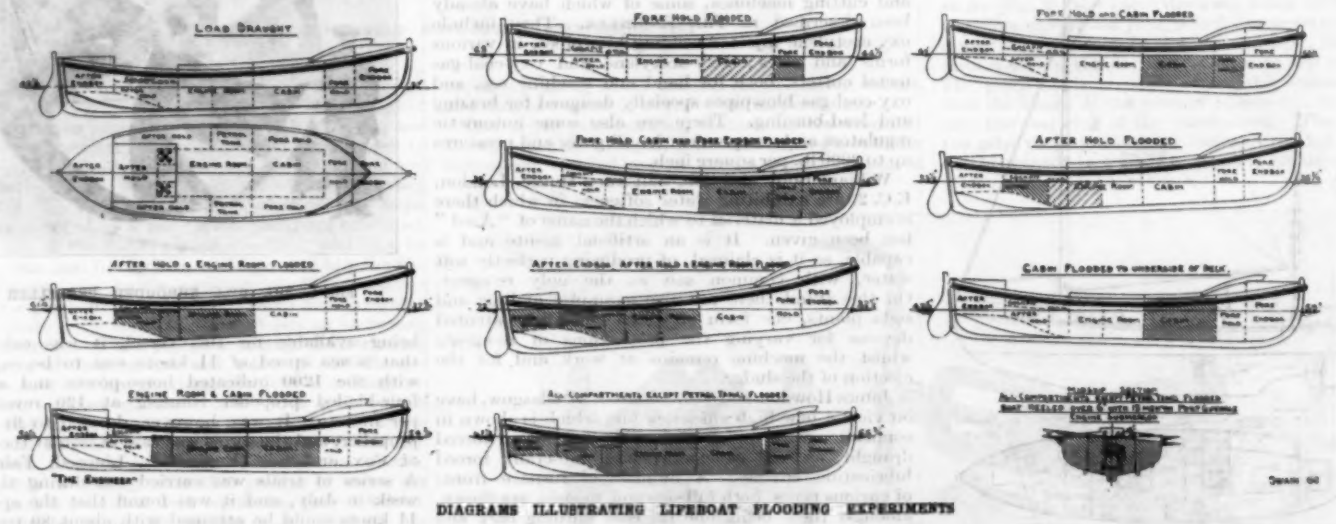
THE gold and silver mining industries of Northern Ontario, especially in the Porcupine district, have been greatly handicapped during the last two years by a shortage of hydro-electric power, the generation of which has not kept pace with the expansion of mining operations. A bulletin on hydro-electric development for the gold and silver mines, by A. R. Webster, Inspector of Mines for Ontario, gives the turbine capacity connected to generators owned by the different power companies as follows:—Northern Ontario Light and Power Company, 30,140 horse-power; Northern Canada Power Company, 28,000 horse-power; Great Northern Power Company, 4800 horse-power; Gowganda Power Company, 800 horse-power; Canadian Associated Goldfields, 800 horse-power; South Bay Power Company, 280 horse-power, making a total of 64,820 horse-power. These figures include the installations of the Northern Canada Power Company at Sturgeon Falls and the Great Northern Power Company on Indian Chutes, both of which will be completed during the present year. Work has been commenced on the first 20,000 horse-power unit of a generating station on the Quinze River at Kakake Falls, by the Northern Canada Power Company. This water will permit of a development of 60,000 horse-power. A steel tower line 125 miles in length from the Quinze plant to Porcupine is now under construction. The Ontario Government has granted to the Hollinger Consolidated Gold Mines, Limited, a lease of Island Falls on the Abitibi River north of Cochrane, where from 22,000 to 25,000 horse-power is being developed and contracts for the dam, power-house and generators have been awarded. Power from this source is expected to be available by August, 1924. In addition to the power developed for mining purposes, a total of about 54,000 horse-power has been installed by the pulp and paper companies in this area.

Lifeboat Flooding Experiments.

The series of diagrams accompanying this article shows very clearly the interesting results obtained from some fresh-water flooding trials recently carried out at the Poplar Storeyard of the Royal National Lifeboat Institution. The tests were made on the Tenby lifeboat, which is one of the new series of cabin motor lifeboats of the Watson type. This boat, the general arrangement of which is shown in the two top left-hand diagrams, has the following dimensions:—Length overall, 45ft.; breadth 12ft. 6½in.; depth from the bottom of the keel to the gunwale capping, 5ft. 8in. The measurement from the tops of the end boxes at the stem head and the stern post to the keel bottom is 8ft. 6¾in. and 7ft. 6¾in. respectively.

In the diagrams shown below, a figure is given on the water line at each end of the boat. This represents in inches the depth of the keel fore and aft below the water line. The part of the boat which is flooded is tinted, and the cross-hatching in the diagrams showing the flooding of the fore and aft holds indicates that the hold around the cabin and engine-room is flooded, but not those parts themselves. The total number of air cases fitted is ninety-one.

With regard to the weight of the boat it may be stated that the total weight without counting gear, petrol, or stores, and excluding the crew, is 17.4 tons, and the weight under experimental conditions, including crew and all gear in place, about 20 tons. In the midship section, reproduced at the left-hand bottom corner of the illustration, it will be noted that the engine is completely submerged. This motor, which is one of the Institution's new 99 brake horse-power six-cylinder units, was specially designed for lifeboat work, and a full description of it will be found in THE ENGINEER for December 22nd, 1922. The tests illustrated show the remarkable stability of the Watson type cabin boat under flooded conditions, and form a further interesting addition to the technical records of the Royal National Lifeboat Institution.


LOAD DRAUGHT
FORE HOLD FLOODED
FORE HOLD AND CABIN FLOODED
FORE HOLD, CABIN AND FORE ENDBOX FLOODED
AFTER HOLD FLOODED
AFTER HOLD & ENGINE ROOM FLOODED
AFTER ENDBOX, AFTER HOLD & ENGINE ROOM FLOODED
CABIN FLOODED TO UNDERSIDE OF DECK
ENGINE ROOM & CABIN FLOODED
ALL COMPARTMENTS EXCEPT PETROL TANK FLOODED
"THE ENGINEER"

DIAGRAMS ILLUSTRATING LIFEBOAT FLOODING EXPERIMENTS

TRANSMITTING ELECTRICAL ENERGY FROM NORWAY TO DENMARK.

One of the subjects discussed at the Engineering Congress at Gothenburg was that of transmitting the electric current from Norway to Denmark. The estimated maximum requirement of electric energy in Denmark 10 years hence is placed at about 160,000 kilowatts, with a minimum load of 63,000 kilowatts. The present plan, however, only provides for a consumption of 42,000 kilowatts supplied to the five principal towns of Denmark.

The Committee which has the matter in hand proposes four transmission schemes as follows:—(1) High-tension direct current at 110,000 volts to Aarhus and Copenhagen, where it would be converted to 50,000 volt alternating current; overhead conductors in Norway and Denmark; sea cables under the Skagerack, and the Belts of 130 kiloms. and 60 kiloms. length respectively. (2) High-tension direct current at 110,000 volts overland from Norway by way of Trollhättan and Hälsingborg, in Sweden. This would require only comparatively short sea cables under the Sound and the Belts. (3) Three-phase current at 132,000 volts overland across Sweden, transformed at Hälsingborg, in Sweden, to 50,000 volt, thence by sea cable under the Sound. (4) Same as the foregoing, but no stepping down at Hälsingborg, whence conducted across the Sound at the narrowest place on aerial cables.

There is, it is said, no appreciable difference in cost between the different schemes. For 42,000 kilowatts it would be about 50 to 60 million Danish kroner. The annual cost per kilowatt, according to this estimate, would be between 225 and 250 Danish kroner with 50,000-volt three-phase current. With an increase in consumption to about 53,000 kilowatts, the price would be reduced to from 200 to 235 Danish kroner, and with 100,000 kilowatts to from 180 to 210 kroner per kilowatt.

As a *résumé* of the position, it may be said that, as it has proved uneconomical up to the present to transmit power from Norway to Denmark, the solution will probably be found in the linking up of the Norwegian with the Swedish power circuits. The latter already supply electric current to Denmark by means of sea cables under the Sound.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PAYMENT BY RESULTS.

Sir,—The note in your Seven-day Journal on payment by results in the issue of THE ENGINEER of August 24th is of real interest to all who are engaged in fixing piece-work prices. The correspondent who suggested to the editor of the *Daily Telegraph* a scheme whereby a number of skilled, energetic workmen should be paid a fixed wage to demonstrate the method and time by actual trial of all new jobs, described a scheme which has already been followed with good results by several of the leading firms in this country; to name one only, John I. Thornycroft and Co., Limited, Basingstoke, have employed this system for some years with marked success. Rate-fixing generally is a very difficult problem; much has been written of various methods of giving satisfaction to the worker and the employer, and firms of world-wide reputation have published most interesting books on the subject and its various branches, viz., motion study, speeds and feeds, factory lighting, &c. But although these publications are most useful, it must be remembered that they describe systems which suit their authors' business, production scheme, and product only. To attempt to lay down a general scheme for all industries would lead to disappointment and failure. Each product and factory organisation is a law unto itself, and should be treated as such.

A successful rate-fixer should be an individual who has had a wide and varied experience of the manufacture of the class of work for which he has to fix piecework prices, for the confidence of the worker can never be obtained when it is obvious that the man who fixes the rate has not had actual experience of the class of machine and product for which he has to fix a time limit. A tendency nowadays is to rely too much on working to the "book." Rate-fixing of this kind where "speed-and-feed" is relied upon mainly and other just as important details disregarded, have earned the members of many rate-fixing offices the title of "Guesstamator," and not without due cause.

Perhaps it will not be out of place at this moment to attempt to state a few of the factors that should be considered when fixing a rate for a new part or operation. First, the type of machine on which the operation is to be performed. It will be readily admitted that to drill and tap twelve 1in. Whitworth holes 1in. deep, on a radial driller with a 2ft. 6in. arm will take a much shorter time than the same operation done on a machine twice as big, although the speed and feed in both cases may be the same. Another factor may be that in one instance the operator can handle the casting alone, and in another, although the work to be done is the same, a crane or lifting tackle may be required. For evidence that these factors are neglected, one has only to remember the many complaints of operators who, although their work is much more laborious than when similar operations are performed on smaller machines, rarely earn more than a small portion of the bonus earned on the smaller machine.

Another factor is quantity. To fix a price on, say, batches of fifty and then issue in lots of ten is asking for dissatisfaction. A method of avoiding this trouble is taken advantage of by some rate-fixers by giving a setting up and breaking down time separate from the actual operation. This plan has much to commend it, as by it the operator is least penalised for the varying quantities of the batches. To see that other factors exist one has only to remember the great difference in old and modern plant, the difference in jig tools, &c., the class of finish required, the material used, the general type of operators available, &c. &c. To keep the general class of operator fairly satisfied, and their earnings in something like proportion to their ability, is rather a problem, but if the rate-fixer takes into consideration the many factors that have a direct bearing on each part dealt with, and remembers that the cutting or final assembly is often but a small part of the total, and if he be assisted by the right kind of demonstrator, rate-fixing loses most of its uncertainty and worry, and, what is of more importance, the employer and employee are fairly happy and the latter's "grousing" becomes rare instead of regular.

Basingstoke, August 29th. H. T. FOWLER.

EMPIRE DEVELOPMENT AND EMPLOYMENT.

Sir,—May one hope that one of the certain effects of the Exhibition of 1924 will be to make the British Empire self-contained; in other words, without any intention to exclude foreign goods, as such, to co-ordinate our requirements and resources in a more practically patriotic way. If there is a demand for timber within the Empire, then let us see how best we can grow such timber, and so on.

Complementary to this policy, it might also be well for our various trades and industries to combine and maintain a staff or Committee of Inquiry not only to ascertain how best our manufactures may be sold in existing markets, but also how to create markets for our goods. To be more explicit; in the engineering trade it seems to me that we stay at home and patiently wait for orders to come to us, whereas we might, with immediate and immense advantage, follow the example, and even the footsteps, of our missionaries. Visualise the Empire as your personal property, would you not speedily see to it that every surface acre and every sub-surface acre yielded the utmost profit. A missionary recently told me that his parish or field was about the size of England, and amongst other wonders described two gigantic waterfalls which he, or his colleagues, had discovered. Now my contention is that my proposed Engineering Trades Committee should send out experts to report on this power reserve as to how it could best be harnessed to develop and exploit the vast wealth of the adjoining country. Under our present practice it is not unlikely that some foreigner will acquire the rights, and obtain engineering and other supplies from his own country, thus losing the trade to our own. This is not idle conjecture, but only what is being done where we now hold a mandate. What we want are engineering missionaries.

Even the Exhibition of 1924 will fail in one of its main objects unless we make haste to take advantage of this all-important point. As I see it, our emigration system aims at an agricultural Empire. Food is a very good thing, and farm labourers a very good class, but they have not the education or enterprise to create a demand for our engineering products, which are the finest in the world.

Tramping over rich deposits of potash, thousands toiled along on their gold quest to Klondyke, where they died from poverty and privation. There is no such thing as waste, but, rather, a use for everything if only we have the energy to apply ourselves intelligently and industrially.

Town advertising brings trade to our holiday resorts. Why not trade publicity and organisation? The engineering trade is organised against certain domestic developments; what is even more urgently needed is a forward offensive to secure British trade for British workmen, otherwise our skilled men must continue to emigrate and our trade decline to a profitless point. The matter is too urgent to permit of any further delay or futile following of old-time methods. The wolf is nearly at the door, and it is essential that we be up and doing at once. Nicely worded phrases do not fill the cupboard with comfort.

Missionaries create and cater for their congregations. Engineers could and should cater and create new markets for their own products.

It may be urged that work of this kind is the province of the banks or Stock Exchange, or company promoters. Allowing this to be so, the bitter fact—as our million unemployed testify—is that efficient exploitation of our Empire overseas has not been taking place. Capital is quickly found for foreign schemes, and should be assuredly available for Empire requirements, if we organise now efficiently and with initiative. Money makes money, and industry begets industry. When we have provided for our own financial needs it will be time to employ the spare surplus in the development of opposition or rival trade resources.

Our national credit depends directly on our trade, and our Empire trade could and should employ profitably our financial resources. As it is we very curiously boast of London as the hub of the money world, and how other nationals must come here for financial accommodation.

To paraphrase the picture in the Tate Gallery, illustrating the "North-West Passage," the thing can be done, and the engineers should do it.

London, August 27th. D. S. M.

ANNEALING.

Sir,—*Re* your article on "Annealing" in the issue dated 24th inst.

I should think the lengthening of a chain due to the straightening of the links could easily bring about a "severe strain-hardened" condition, which, you say, would be undoubtedly softened—that is, improved—by the usual form of annealing. I never understood why links should be made curved instead of straight-sided.

Leicester, August 24th. ARTHUR F. WOODCOCK.

SHORT HISTORIES OF FAMOUS FIRMS: SHARP, STEWART AND CO.

Sir,—In my article on the above in THE ENGINEER of August 24th, a misprint occurs on page 196, column 3. The date of the ten "single" engines for the Midland Railway—Fig. 5—should be 1853, not 1863, as printed. The date under the illustration is correct.

August 28th. E. L. AHRONS.

The Shipping, Engineering and Machinery Exhibition.

No. I.

IT is, of course, difficult to appraise an exhibition even only one day before it is opened, but a preliminary visit which we made to Olympia, where the Shipping, Engineering and Machinery Exhibition opened to-day, August 31st, gave the impression that the show will be decidedly interesting. The floor, as is usual on such occasions, was littered with packing cases and rubbish, but we could discern the outlines of several novel exhibits, while it was obvious that the character of the machinery shown is more catholic than ever. The addition of the new building, which must be roughly half as large as the original Olympia, has naturally added to the facilities for the display of large exhibits and is occupied by the motor boat section. It is proposed that a number of the scientific and technical societies shall pay official visits to the Exhibition, which remains open till September 22nd. We begin in what follows our account of some of the exhibits.

One of the most extensive exhibits at the show is the display of motor boats, marine and stationary

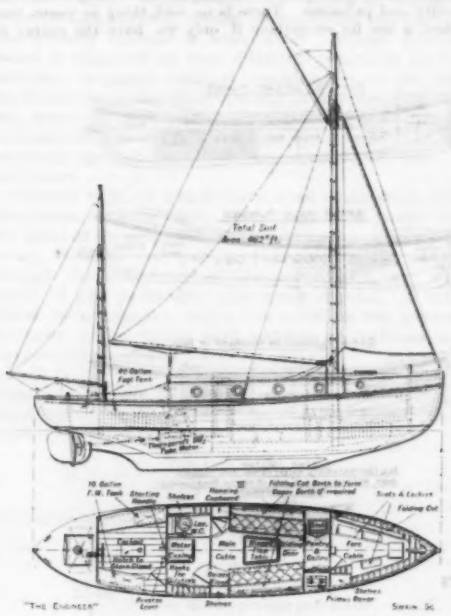


FIG. 1—35-FOOT SAILING MOTOR YACHT

engines, oil fuel gear and ship models, &c., by John I. Thornycroft and Co., Limited, which is to be found in the Motor Boat and Marine Section of the Exhibition. Briefly, the exhibit comprises a Thornycroft 35ft. sailing motor yacht (9 tons T.M.), of which we give a general arrangement and sail plan in Fig. 1. This boat has a hull of mahogany, and is equipped with a Thornycroft DB/2 type 9 brake horse-power engine. She is of similar, but larger, design to the 7-ton Gamecock, exhibited at the Motor Boat Show in 1921, and has been designed for single-handed running, either under power or sail. There is, it will be noticed, comfortable accommodation for lengthy sea cruising. Another exhibit on this stand is a 20ft. clinker-built ship's boat equipped with a similar Thornycroft type DB/2 engine developing 7½ brake horse-power on paraffin fuel, while a 30ft. open river launch is representative of many similar boats supplied for service at home and overseas. Among the marine and stationary engines displayed on this stand there are the DB/2 engines, referred to in connection with the ship's boat, fitted with combined reducing reversing gear, another similar set coupled to a dynamo for power generating and lighting, and an AB/4 paraffin engine, having four cylinders developing 26 to 30 brake horse-power, of which we give an engraving in Fig. 2. This engine is fitted with reverse gear and standard stern gear. This type is particularly suitable for the lighter types of cruisers and for high-speed work generally. The M/4 four-cylinder 30 to 36 brake horse-power engine, which we also illustrate—see Fig. 3—is fitted with reducing reversing gear and standard stern gear, while another engine of the same type has plain reversing gear. There is a four-cylinder 50 to 65 brake horse-power engine fitted with reducing reversing gear and standard stern gear, and a paraffin emergency lighting set fitted with a radiator and fan, all on one bed-plate, of a type which we have already described. On this stand there is also one of the twelve-cylinder engines, developing 375 brake horse-power, which have been designed by the makers for fitting in hydroplanes, coastal motor boats, &c. There are also some examples of Thornycroft oil-fuel burning gear for use on marine or stationary boilers, and some specimen Thornycroft propellers.

The British Oxygen Company, Limited, of 69, Horseferry-road, S.W. 1, has a stand on which there are demonstrated at work several welding and cutting machines, some of which have already been described in THE ENGINEER. They include oxy-acetylene injector welding blowpipes, in various forms and sizes; oxy-acetylene and oxy-coal-gas metal cutters, both for hand and machine use, and oxy-coal-gas blowpipes specially designed for brazing and lead-burning. There are also some automatic regulators and compressors for all gases and pressures up to 2000 lb. per square inch.

William Boby and Son, Salisbury House, London, E.C. 2, are exhibiting water softeners in which there is employed a material to which the name of "Azed" has been given. It is an artificial zeolite and is capable, so it is claimed, of producing perfectly soft water, with common salt as the only re-agent. On this stand there are also examples of lime and soda plants, one form of which embodies patented devices for varying the proportions of re-agents whilst the machine remains at work and for the ejection of the sludge.

James Howden and Co., Limited, of Glasgow, have on view a new high efficiency fan, which is shown in connection with the maker's system of hot-air forced draught, as well as examples of two-crank forced lubrication engines. A number of furnace fronts of various types, both full size and models, are shown, amongst them being one for coal burning only and another suitable for burning coal or liquid fuel individually. The Howden Ljungström air preheater, which is also shown on this stand, and has been mentioned before in THE ENGINEER, makes it possible, the makers say, to recover from 70 to 75 per cent.—depending on circumstances—of the heat contained in the waste flue gases, and a boiler efficiency of 88 per cent. has been obtained. A 250-kilowatt turbo ship lighting set is also shown on this stand, together with a 30-kilowatt ship lighting set driven by a high-speed engine.

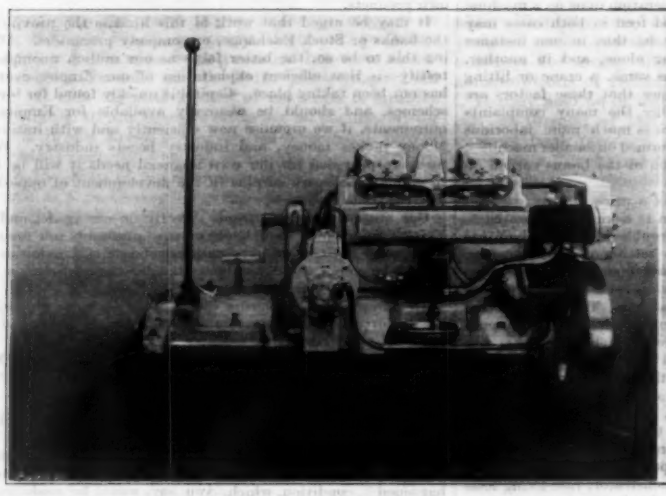


FIG. 2—THORNYCROFT 26/30-B.H.P. MARINE PARAFFIN ENGINE

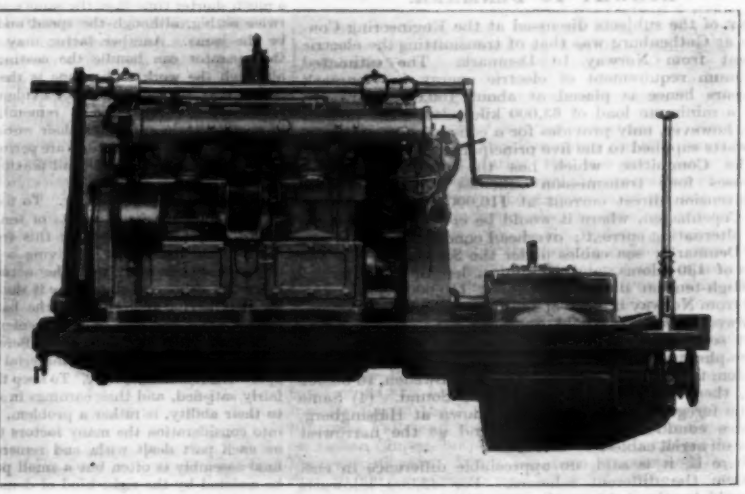


FIG. 3—THORNYCROFT 30/36-B.H.P. MARINE ENGINE

The Gill Propeller Company, Limited, of 17, Victoria-street, London, S.W. 1, is exhibiting samples of the Gill propeller in sizes up to 6ft. in diameter, cast in iron and bronze, together with photographs illustrating the jet system of propulsion, which we have already dealt with. The propeller, as will be seen from Fig. 4, is of the shrouded type, and to that extent it is not novel, as many shrouded propellers have, of course, been produced in the past. The Gill type is, however, claimed to represent a great advance on its predecessors, and within the last few months has been fitted to several fair-sized vessels. The outstanding features about the design are the contraction of the shrouding, from forward to aft, and the increase in the pitch of the blades in the same direction. The natural result of this form is an acceleration of the water as it passes through the propeller, and a concentration of the jet projected astern. The makers say that these propellers can be run efficiently at higher speeds than the normal open type of screw, and, consequently, can be made of a smaller diameter for a given power. The Gill propeller, which we illustrate in Fig. 4, has been fitted to the steam salvage vessel Ringdove's Aid, of the Falmouth Docks and Engineering Company. This vessel is a composite-built, ex-naval sloop, almost identical with H.M.S. Greyhound, made famous by Mr. W. Froude's classic towing experiments. A new and specially built set of compound engines, by J. Samuel White and Co., has been installed, and ample propulsive data

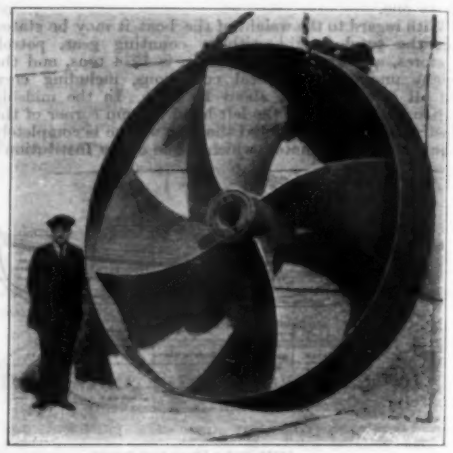


FIG. 4—THE GILL SHROUDED PROPELLER

being available for this vessel, it was calculated that a sea speed of 11 knots was to be expected with the 1200 indicated horse-power and a good four-bladed propeller running at 120 revolutions per minute. It was, however, decided to fit a Gill propeller, and the screw was cast in iron at the works of Cox and Co. (Engineers), Limited, Falmouth. A series of trials was carried out during the first week in July, and it was found that the speed of 11 knots could be attained with about 80 per cent. of the indicated horse-power and 90 per cent. of the revolutions per minute, which were calculated as being required. It was also found that the ship handled and steered with remarkable ease, even with the engines throttled down to just turning over at 12 revolutions per minute, while she could, we are told, be stopped in 70 sec. from ringing down, when running at 10 knots. It was also observed that the propeller displayed no tendency to "race" when breaking surface in a heavy swell, or to cant the ship when going from ahead to astern.

W. H. Dorman and Co., Limited, of Stafford, are exhibiting a number of petrol engines suitable for driving motor cars and wagons, a large number of Flexstel piping joints, and several wave-power transmission equipments. The latter include a single-drill stationary set, a three-drill generator driven by a Dorman engine and mounted on a light railway truck, and the portable plant shown in Fig. 5. We have already—see THE ENGINEER of October 27th and November 3rd, 1922—described the wave-

power system of transmission, so it is unnecessary to enlarge upon it here, but the set which we illustrate is the latest development in the direction of making the apparatus easily transportable. It is capable of operating three rock drills simultaneously, and is driven, through a clutch and oil-immersed chain, by the engine which is also used for propulsion.

FIG. 5—DORMAN PORTABLE WAVE-POWER TRANSMISSION SET

Worthington-Simpson, Limited, of Pimlico and Newark, have confined themselves to samples of auxiliary machinery required in the shipbuilding and marine industry. The main feature of the exhibit is a group of three vertical double-acting boiler feed pumps, and three examples of this type of pump are exhibited. They are of the following sizes:—20in. and 14in. by 32in., 10in. and 7in. by 24in. and 6½in. and 4½in. by 8in. The largest size has a capacity of 23,000 gallons of water per hour at a speed of twelve double strokes per minute; the smallest size 940 gallons at twenty double strokes. These pumps are designed for working pressures of both steam and water of 300 lb. per square inch and are provided with the Worthington-Simpson simplex marine steam valve gear, which will start in any position and is positive in action while the length of stroke of the pump is assured. A direct contact feed-water heater, also shown, is capable of dealing with 4300 gallons of water per hour, and is provided with regulating gear. A horizontal duplex pump for dealing with cargo oil has cylinders 14in. and 11in. by 15in. and is of the pot-valve type, the valves being fitted into separate pots so that examination and renewal is simplified. The valves themselves are of the Worthington streamline form, while the valve seats are made of separate rings so that they can be easily and cheaply renewed. This pump is designed for steam pressures up to 180 lb. per square inch, and a delivery pressure of 250 lb., and has a capacity of 200 tons per hour of crude oil. Besides some smaller pumps for various services, there is, on this stand, a 12in. standard low lift centrifugal pump, with double suction enclosed type impellers, having a normal capacity of 1600 gallons per minute against a total head of 27ft., at a speed of 550 revolutions per minute and an efficiency of 78 per cent. This pump is shown driven by a Sisson vertical forced lubrication engine, which has an output of 20 brake horse-power at 550 revolutions per minute. The engine is connected to the pump shaft by means of a flexible coupling, and there is provision for another flexible coupling at the other end of the pump shaft, since in marine work a duplicate engine is often called for. There is also shown a horizontal duplex double-acting feed pump and a couple of air compressors. One of these is an 8in. by 6in. machine, and supplies air for the operation of a vertical oil fuel pump working on the stand. The compressor is driven by a 22 horse-power motor with a control panel by the British Thomson-Houston Company, Limited. The motor is working on the 220-volt direct-current circuit, and runs at a speed of 800 revolutions per minute.

One of the most striking features on the stand of Robey and Co., Limited, Lincoln, is a single-cylinder high-speed vertical engine with a cylinder 4½in. in diameter by 4in. stroke. It runs at 500 revolutions per minute, and drives directly a 4-kilowatt 105-volt dynamo. Some of the most novel exhibits on this stand, however, are among the auxiliary apparatus, such as filters for oil and water, valves, &c. A new type of valve, which has been specially devised for controlling the high-pressure air supplies of Deisel engines, is shown in Fig. 6. As will be seen from the sketch, these valves are designed to give a clear way to the flowing fluid when they are full open. A circular symmetrical shape is maintained throughout the bore, which naturally gives the minimum of disturbance and friction, while the faces of the valve and seat are protected by the way in which they are arranged with regard to the rush of the fluid in use. The valve face and bearing seat can be ground up in a rotary manner like an ordinary valve, and the seat-piece can be easily removed from the chest when overhaul becomes necessary. No other joints require to be broken beyond that of the cover. The valve cylinder is extended a short distance for fitting a pair, or more, of U-shaped packing rings, and as these fill out with any air that attempts to pass the cylinder during the opening or closing of the valve, they prevent leakage or air loss during this operation. The cylinder, on its top edge, is provided with a sharp bearing ring, that engages the valve cover and beds into a soft copper ring, which provides a sound and tight air seal against the high internal pressure. It will be noticed that the handle is made with a sharp ring edge on its under side, which engages a soft ring of copper or similar metal embedded into the cover top. This forms a tight metal to metal joint and allows a certain amount of resilience when the valve is being tightly closed. The body and cover are made of drop forged steel, and all passages are machined from the solid metal. The valve seat and spindle, &c., can either be made of stainless steel or Monel metal.

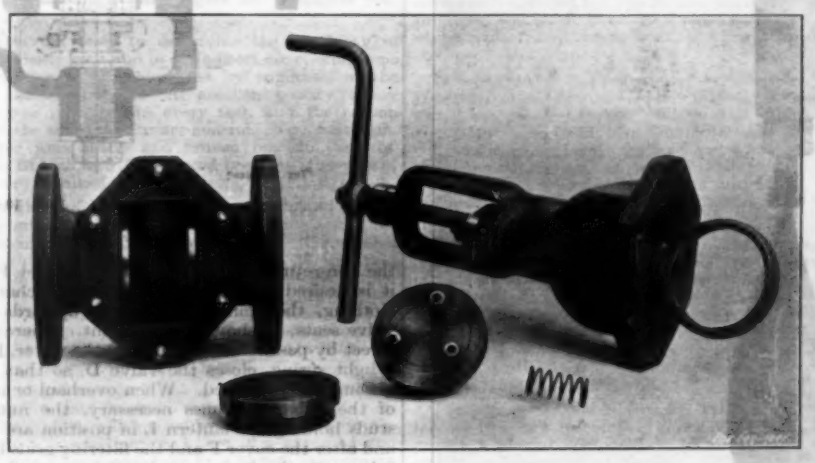


FIG. 7—ROBEY FULL-WAY VALVE

In order to eliminate the necessity for breaking pipe joints on the line when leaky valves of the parallel slide type—shown in Fig. 7—have to be dealt with, the apparatus indicated in the drawings—Fig. 8—has been introduced by Messrs. Robey. It is intended for grinding together the valve discs and seats without it being necessary to break any joints beyond that of the valve cover. As is shown at A—Fig. 8—the valve discs are fitted with a series of rollers or screwed pins, which are arranged in such a way that they can be screwed out from the rear or inward side of the discs and placed on the front side. The pitch circle is made of suitable dimensions so that the heads of the pins or rollers can be inserted into the seat ring of the valve chest. The heads of the pins project a certain distance so that the disc can be rotated in a truly concentric manner, and the faces will be held in true circular alignment for facing or regrinding. After the grinding operation is finished the rollers or pins can be removed from the front of the disc and replaced on the rear or inward side B—Fig. 8. They are placed there out of the way and

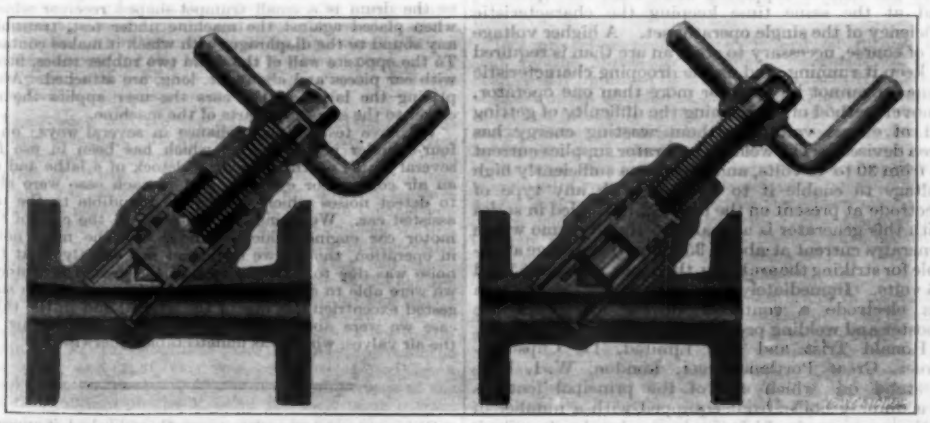


FIG. 6—ROBEY HIGH-PRESSURE AIR VALVE

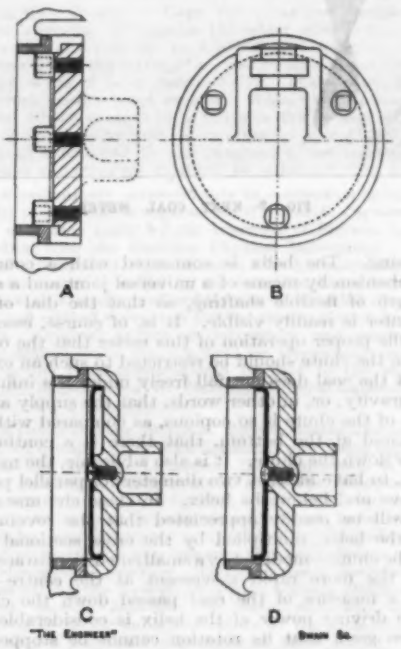


FIG. 8—REGRINDING VALVE

form part of the valve structure, but are always at hand for any overhauling that requires to be done. No special tools are required beyond a spanner. As an alternative to the pin and roller arrangement a plate, made with a flange-shaped edge, is sometimes placed in a recess of the valve disc, and held in place by a set screw—as shown at C, Fig. 8. The plate, when placed on the disc in the working position, is arranged to be clear of the bearing faces and to allow opening and closing of the valve without being in the way or forming any obstruction. Should facing or regrinding operations become necessary, the valve is dismantled, and the plate placed in position—as shown at D, Fig. 8.

George Kent, Limited, of High Holborn and Luton, have a stand on which there are exhibited a number of meters and recorders for steam, gas, water, &c., and a new type of apparatus for measuring the flow of coal down chutes, which we illustrate in Fig. 9. This device, it will be seen, takes the form of a simple helix, which is arranged in the centre of the chute and the number of revolutions which it makes is a measure of the coal or other granular material

FIG. 9—KENT COAL METER

passing. The helix is connected with a counting mechanism by means of a universal joint and a short length of flexible shafting, so that the dial of the counter is readily visible. It is, of course, essential to the proper operation of this meter that the outlet from the chute should be restricted to such an extent that the coal does not fall freely under the influence of gravity, or, in other words, that the supply at the top of the chute is so copious, as compared with the demand at the bottom, that there is a continuous flow down the chute. It is also advisable, the makers say, to have at least two diameters of parallel piping above and below the helix. In these circumstances it will be readily appreciated that the revolutions of the helix, multiplied by the cross sectional area of the chute—modified by a small co-efficient to account for the more rapid movement at the centre—will be a measure of the coal passed down the chute. The driving power of the helix is considerable, and is so great that its rotation cannot be stopped by grasping the shaft with the hand, but the moving parts are, nevertheless, mounted on ball bearings so as to ensure an absolutely positive action. The makers say that the accuracy of this meter can be relied upon to within 2 or 3 per cent.

The characteristic feature of the Robey feed-water filter, also exhibited, is the controlling valve—illustrated by the drawing, Fig. 10. The valve A is attached to the lower end of the filter chamber B, and can be raised or lowered by rotating the hand wheel at the top, when the screw C works out of or into its nut. In the lower position, as shown on the left, the valve makes contact with its lower seating, and the water is sent upwards into the casing, through the filter, downwards in the centre, through

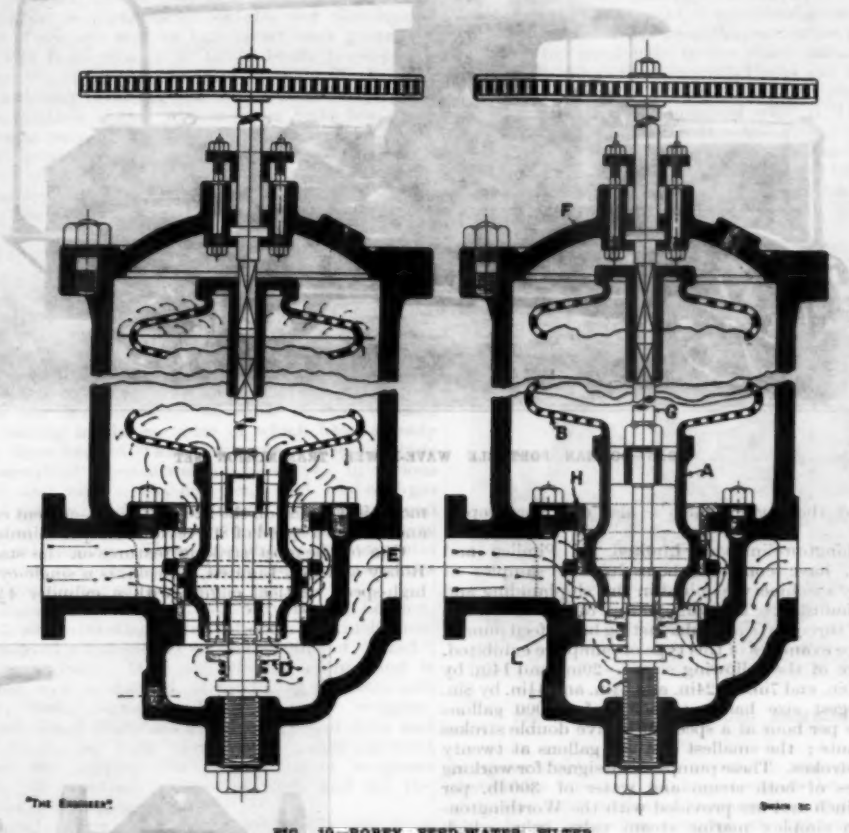


FIG. 10—ROBEY FEED-WATER FILTER

the non-return valve D and to the outlet E. When it is desired to cut out the filter, for changing the clothing, the spindle is screwed upwards and the valve seats, as shown on the right. There is then a direct by-pass to the outlet, and the water, helped by a light spring, closes the valve D, so that the filter is completely isolated. When overhaul or inspection of the valves becomes necessary, the nuts on the studs holding the lantern L in position are removed, and after the cover F and the filtering grids have been taken off, the lower spindle G is rotated until the valve A has engaged the upper seat. The screw on the lower end of the spindle G lifts up the lantern L, and the complete valve arrangement comes out of its recess, so that all the parts can be examined conveniently. The seat H is screwed into the lantern L and is arranged for easy removal, so that the valve A and its attachments complete can be withdrawn if required.

The Premier Electric Welding Company, Limited, a constituent company of Nobel Industries, Limited, is showing a multiple arc D. C. welding plant designed with the idea of supplying more than one operator, and at the same time keeping the characteristic efficiency of the single operator set. A higher voltage is, of course, necessary to start an arc than is required to keep it running, and as the drooping characteristic dynamo cannot be used for more than one operator, a novel method of overcoming the difficulty of getting rid of excess voltage without wasting energy has been devised. The welding generator supplies current at from 30 to 40 volts, and thus has a sufficiently high voltage to enable it to be used with any type of electrode at present on the market. Coupled in series with this generator is a small boosting dynamo which generates current at about 35 volts, the voltage available for striking the arc being, therefore, between 65 and 75 volts. Immediately the welder starts the arc with his electrode a contactor device withdraws the booster and welding proceeds on the main generator.

Ronald Trist and Co., Limited, 12, Clipstone-street, Great Portland-street, London, W. 1, have a stand on which one of the principal features is a dummy boiler front equipped with a number of fittings, most of which we have already described, including the Raybeam gauge glass illuminator that lights up the meniscus inside the glass, and thus shows up the water level prominently. The exhibits of C. A. Hunton and Sons, 71, Southwark-street, London, S.E., 1, are confined entirely to punching and shearing machines, among which the largest is a combined punching, plate section and bar shearing, mitre cutting and notching machine, which is capable of punching holes up to $1^{3}/_{16}$in. in diameter through $\frac{7}{16}$in. plates, and will cut joists up to 9in. by 4in. The Vono Company, of Dudley Port, Staffs., is exhibiting some of the excellent parallel jaw vices, which we described in connection with the recent British Industries Fair; while Wailes Dove Bitumastic, Limited, of Newcastle-on-Tyne, demonstrate the protective qualities of Bitumastic compositions against corrosion by acids, hot and cold water. On the stand of C. A. V., Limited, Acton Vale, there are a number of dynamos, starters, combined dynamotors, automatic dynamo and light control boards, instruments, cut-outs, cabin lights, syrens, searchlights, signalling gear and navigation lamps.

SPOTANOK

A NEAT little instrument called "Spotanok" is being placed on the market by Taylor, Gibsons Limited, Stowell-street, Newcastle-upon-Tyne. It has been designed specially for motor car owners, for, as its name suggests, the purpose of detecting and localising noises in machinery, but in many engineering works it will also be found useful. Practical engineers have been in the habit of making use of a strip of wood or a steel rule, one end of which is placed between the teeth and the other end is applied to the machine to find the source of noise and with good results; but in inaccessible places this method is difficult, if not impossible, to apply.

The Spotanok is a stethoscopic device which occupies a very small space and can be applied to parts otherwise inaccessible. It comprises a hollow metallic drum about the diameter of half-a-crown and $\frac{1}{4}$in. thick, one wall of which consists of a thin celluloid diaphragm. Hinged to the drum is a small trumpet-shaped receiver which, when placed against the machine under test, transmits any sound to the diaphragm with which it makes contact. To the opposite wall of the drum two rubber tubes, fitted with ear pieces and about 3ft. long, are attached. After placing the latter in the ears the user applies the receiver to the suspected parts of the machine.

We have tested the appliance in several ways: on a four-cylinder petrol engine, which has been in use for several years; on the geared headstock of a lathe and on an air compressor cylinder, and in each case were able to detect noises which were quite inaudible to the unassisted ear. We found, for instance, in the case of the motor car engine, which cylinder was the most noisy in operation, though we could not say exactly what the noise was due to. In the case of the geared headstock, we were able to detect a noise from the gears which suggested excentricity in one of the wheels, and in the third case we were able to hear quite clearly the seating of the air valves, which was undetectable otherwise.

FROM some correspondence recently published, it appears that coal from the Blaenmawr Colliery to the Midland Railway (London, Midland and Scottish) depôts in London, is conveyed by the Great Western to Bordesley Junction, Birmingham, and there handed over to the London, Midland and Scottish Company. This means a journey of 280 miles instead of 170 miles *vid* Swindon. In the latter case it could, we believe, be transferred at Acton. The complainant thought that this would allow for the rate to be reduced, but this is not so, as the charges are based on the shortest route.

Railway Matters.

The report by Sir William Acworth on the finances of Austrian railways has now been presented to the League of Nations' Commissioner in Austria.

A recent telegram from Rome to the *Matin* stated that an agreement will shortly be concluded in Paris between Italy, Great Britain and France for the construction of a new and important railway in Anatolia.

The railwaymen's conference on the shopmen's wages question was resumed on Friday last at the Ministry of Labour, again without success. The dispute has been temporarily left in the hands of the Ministry, which is trying to bring about a settlement. The strike notices are still suspended.

On Thursday last a passenger train on the Great Western Railway became divided. Most newspaper reports, in mentioning the incident, said that the train was pulled up by the guard. This was, though, very unlikely, as the separation would part the vacuum brake connections and, air being admitted, the brakes automatically would be applied.

The Manchester and District Traders' Confederation on Railway Rates and Charges has just issued a "Traders' Guide to the Revision of Railway Rates," in view of the forthcoming consideration by the Railway Rates Tribunal of the proposed standard charges submitted by the companies. These include questions of collection and delivery, cartage charges, private siding conditions, &c.

A party of railway officials from Soviet Russia recently paid a visit to Harbin to make arrangements for the resumption of through traffic on the Trans-Siberian and the Chinese Eastern Railways. Arrangements have been made, it is reported, between the Soviet Government, the Chinese Eastern Railway, and the International Sleeping Car Company, for resumption of the through traffic on these lines.

The State Railways have begun the distribution of orders for the material needed for the electrification of the line between Stockholm and Gothenburg. The following are among the orders placed:—The Svenska Metallverken, copper wire to the value of Kr. 3,000,000; the Domnarvets Jaernverk, 500 tons of iron; the Ljungs-grens Verkstaeder at Kristianstad, 800 contact poles and other constructional iron work. The time for the receipt of tenders for 50 electric locomotives expires on December 1st and for the converter stations on December 10th.

The project for the building of a vehicular and electric railway bridge across the Niagara River at Fort Erie, Ontario, is making headway. The Buffalo–Fort Erie Public Bridge Company, Limited, which has secured Canadian and American charters, has elected officials as follows:—President, W. M. German, of Welland; vice-presidents, Dr. William Douglas, Fort Erie, and Donald McGillivray, Port Colborne; secretary-treasurer, F. W. Wilson, Fort Erie. The cost of the structure will be between 3,000,000 dollars and 4,000,000 dollars. Plans of the work have been submitted to the United States War Department and the Dominion Department of Public Works for approval.

Schemes for the absorption of the Brighton and Dyke Railway by the Southern Railway Company, the Midland and South-Western Junction by the Great Western, the Leek and Manifold by the London, Midland and Scottish, and the Mid-Suffolk by the London and North-Eastern have been prepared by the Railway Amalgamation Tribunal. The Midland and South-Western Junction scheme has already been accepted by the proprietors, and it is expected that the other three will receive similar approval. The only outstanding absorption will then be that of the South Yorkshire Junction Railway, in which the Denaby Main Colliery Company and the Ministry of Transport are concerned. This may go to the Court of Appeal.

The Inchcape reports on the retrenchments in India contained the following paragraph: "We are convinced that in a country like India, with her vast territory and differing people and circumstances, it is an impossibility to control the details of all the railways from Delhi and Simla as at present. Decentralisation is, in our opinion, essential if the railways are to be developed on economic lines. It is generally agreed that large economies could be effected by grouping the railways on the lines recently adopted by Great Britain, and we recommend that the preparation of a scheme be taken up forthwith." In the *Railway Gazette* for the 10th inst. a scheme, prepared by that paper, was published in which the Indian railways were divided into five groups.

Next week will see the anniversaries of two serious railway accidents. It will be eighteen years to-morrow—September 1st—since the derailment of a Great Eastern express at Witham, in which ten passengers and one servant was killed. There were two unusual features about this accident. One was that the late Colonel von Donop was unable to find out the cause and had written his report to that effect when evidence unexpectedly cropped up that the permanent way gang had taken some keys out of the knuckle of a crossing as the express was approaching. The other strange feature was that a carriage, standing all alone, had all the woodwork of its upper portion destroyed by fire subsequent to the derailment. It was supposed that there was an escape from the gas pipes and that this was somehow ignited by a spark. Sunday next will be the tenth anniversary of the Ais Gill collision on the Midland Railway, when a train from Glasgow came to a stand, owing to want of steam, in the section and was run into by a train from Edinburgh. The driver of the latter, it may now be said at this late day, missed seeing the distant for Mallerstang box and was then misled by the signalman there failing to act to rule 40 (*a*) and keeping his home signal at "danger" until the train was nearly to a stand. Sixteen passengers were killed—all in the first train. Driver Pepper was subsequently tried and convicted for manslaughter, but it is to the credit of the Midland Railway Company that he was afterwards reinstated in the service and remained there until his death last year.

Notes and Memoranda.

The extent of the oil shale deposits of Tasmania is estimated, by the Government geologist, at 42 million tons, while the oil content is 40 gallons per ton.

Tests on beams of limestone which are continuously loaded to a stress of two-thirds of the breaking load have shown, according to the *Canadian Engineer*, practically no increase in deflection during the month. Apparatus is being constructed for making fatigue tests on stone under direct compression.

Some particulars are given in the *Canadian Engineer* of the apparatus used at the Keokuk dam, across the Mississippi, for relieving the gates of ice pressure during the winter. Opposite each gate there is a 3in. pipe which reaches 10ft. below the water level. Air, at a pressure of 70 lb. per square inch, is discharged from these pipes, and by inducing a rising current of water, melts the ice in front of the gates.

The Second National Radio Conference, which met last March, introduced a method of designating radio waves which may not be familiar to all those interested in radio work. This is the use of frequency in kilo-cycles and is advocated instead of wave length in meters. The change, it is said, would result in many advantages, and it is believed that cycles per second will eventually replace the familiar term wave length.

A new type of belt conveyor, used at the Berlin trunk line telephone exchange, is described in the *Machinery Market*. It comprises a belt, passing along the record tables, the action of which is based on the fact that the friction coefficient of paper on metal is only half as much as that of paper on textile fabric. The order bulletin is slipped in between the moving belt and a metallic guide sheet, and on account of the greater friction it moves along with the belt.

According to *The Times*, it is expected that it will be possible to use hafnium in the manufacture of audion lamps in wireless telegraphy. A Dutch firm is now investigating the possibilities of its use in this manner. In Norway and Greenland minerals containing hafnium have been discovered. It is hoped that hafnium in great quantities may be found, and an expedition will probably be sent to Greenland to investigate the geological conditions.

Carburisation tests to determine the possibility of making synthetic grey iron in an indirect-arc rocking-type electric furnace have been made by engineers of the American Bureau of Mines. An excellent quality of grey cast iron was produced in every test, and the carbon content of the metal was under control. Test bars 1¼in. in diameter were made and broken on 12in. centres. Deflections as high as 3.65 deg. and breaking strengths of 3000 lb. were obtained.

The monthly production of iron ore in Poland for the first six months of this year was 38,000 tons, as against 29,000 tons in 1922 and 27,000 tons in 1913. The number of mines in operation this year amounts to 25, and that of men employed to 5700. The yearly output per worker now is 71.6 tons, as against 96.3 in 1912. Following the great war, the output per man was 68.4 tons in 1919. It fell to 51 tons in 1920, the year of the Russian invasion, and rose to 54.5 tons in 1921 and to 62.3 tons in 1922.

A flame of extraordinarily higher temperature, which has been employed in experiment by E. Hauser and E. Rie, is mentioned in the *Chemical Trades Journal*. It is produced by liquid fuel, which is led by a tube from a storage container to a special burner, where it is atomised and forced out into a horizontal cone by a stream of hydrogen or other suitable gas, and combustion is intensified by a mantle of oxygen enveloping the cone from the outer part of the burner. It is estimated that the temperature reached is at least 3000 deg. Cent.

An American committee has, according to the *Chemical Trades Review*, arrived at the conclusion that to serve metallurgical processes directly, large oxygen-manufacturing plants can be built which, by virtue of their large production and correspondingly increased efficiency, together with the fact that no compression in cylinders, storage, transport, or service will be required, will be capable of delivering oxygen for the processes at a cost not exceeding 3 dollars per gross ton. The oxygen is to be of about 99 per cent. purity, and its cost works out at a little over 6d. per 1000 cubic feet.

The protective properties of linseed oil varnish are said, by the *Manchester Guardian Commercial*, to have been greatly improved by a Munich chemist. His method is based on an addition of chromium compounds soluble in oil and belonging to the chromium acid series. While the chromium thus introduced into the anti-rust coating, by its paralysing effect, reduces local electric currents to a minimum, the influence of substances activating the formation of rust, such as carbonic acid, oxygen, alkalis, &c., is counteracted by converting the linseed oil varnish into a compound nearly saturated. Tests made at the German Testing Office of Berlin-Dahlem have shown a "chromo" coating after four years to be preserved perfectly, without any trace of exfoliation.

In rebuilding the foundations of a bridge in Nebraska, it was necessary to find the exact position of an old caisson, which, according to *Electric Traction*, had a taper and was 80ft. to bed rock. A pile driver was set up close to the caisson and a 4in. pipe was driven vertically. A wire was welded to one end of the pipe, and the other was connected to a 6-volt storage battery, which in turn was connected to the steel side of the old caisson through a 150-ampère D.C. ammeter. While the pipe was being driven the ammeter read from 8 to 10 ampères, but as soon as the pipe touched the steel caisson the ammeter showed 92 ampères. Then from the length of the pipe driven below ground and the horizontal distance from the pipe to the caisson at the surface of the ground, the exact slope of the caisson was found. A second pipe was then driven a short distance from the first, and the results checked within 2in. or 3in. In this way it was found that the new bridge pier had to be set 2ft. 3in. farther away in order to clear the old caisson.

Miscellanea.

The Chemical, Metallurgical and Mining Society of South Africa has started an endowment fund for encouraging research.

It is suggested in the *Diamond Fields Advertiser* that a diamond-cutting industry may shortly be organised in Kimberley.

The salt mines at Malagash, Halifax, Nova Scotia, have reached a depth of about 300ft., and the output is about 40 tons per day. The quality is much better than at the commencement of operations.

The coal output at the mines of Great Britain for the week ended on the 4th inst. was 5,253,600 tons, compared with 5,111,700 tons for the previous week, and 5,121,600 for the corresponding week of last year.

The Chinese President recently granted a request of the Ministry of Agriculture and Commerce to dispatch at intervals cruisers to foreign countries, exhibiting Chinese products to promote foreign trade in other countries.

The eighty-third annual show of the Royal Agricultural Society of England will be held at Leicester from Tuesday, July 1st, to Saturday, July 5th, 1924. Copies of the implement regulations, &c., will be ready for issue after January 1st, 1924.

The Institution of Naval Architects announces that the Martell Scholarship in Naval Architecture, 1923—£130 per annum for three years—has been awarded by the Council of the Institution to Mr. F. H. Sears, of H.M. Dockyard, Chatham, and the Earl of Durham Prize to Mr. R. J. Halsey, of H.M. Dockyard, Portsmouth.

It is reported from Johannesburg that an extensive deposit of good manganese ore has been discovered in the Krugersdorp district. The lode has been traced to a depth of 20ft., and apparently runs east by west over an unbroken line of three miles. The surface trenches so far indicate that there must be an extensive deposit of the ore in the adjoining hills.

A seam of coal, 4ft. thick, has been uncovered at Black Brook, Boulardorie, Cape Breton, Nova Scotia, and the discovery indicates one of the largest and most valuable seams of coal found in Cape Breton in recent years. The property is situated at an ideal place for shipping. It is about 500ft. from the main road, and less than 500ft. from the deep water of the Bras d'Or.

It is reported from Bombay that a big irrigation project is being planned for the Gwalior Durbar by the Durbar's own Irrigation Department, which, it is stated, will cost about 300 lakhs of rupees. The object is to bring under cultivation many hundred square miles of fallow land by the damming of the Chambal and other rivers which flow through the Gwalior State. It is understood that the Maharajah intends to spend about 60 lakhs of rupees on this project in the ensuing year.

A report just published by the Bureau of Statistics on Canada's mineral production during the first six months of 1923 shows that the mining industry has recovered from the slump of the last few years. The total value of products amounted to 87,152,248 dollars, being an increase of 44 per cent. over the corresponding period of last year. The gold production amounted to 520,402 fine ounces, valued at 10,964,382 dollars. The silver production totalled 8,336,946 ounces valued at 5,506,489 dollars.

The director of the Norwegian Telegraph Services has recently returned from a tour of inspection in the northern provinces where he prepared the plans for the new wireless station to be erected at Vardoe. This station will, it is said, have a transmission radius sufficient for messages to be sent to the station at Ingoe, near Hammerfest, and to the Meterological Institute's station at Tromsoe. Weather reports are to be sent regularly from Tromsoe, and these will be of very great importance to British and other trawlers fishing in Arctic and White Sea waters.

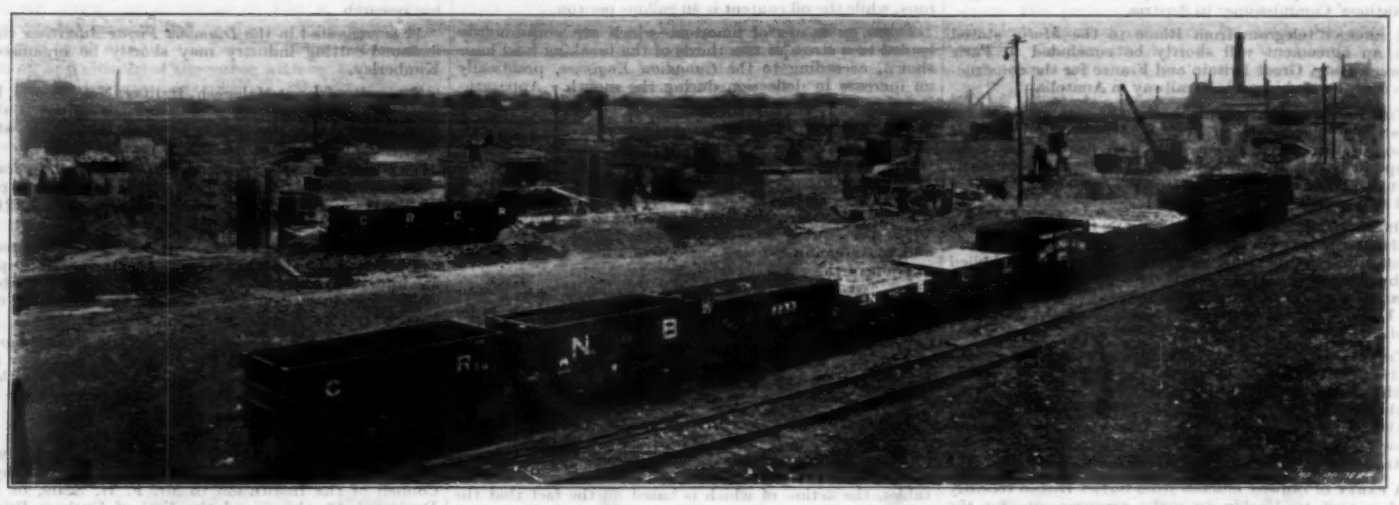
The City Council of Cape Town has just decided to accept a scheme to increase the water storage capacity of its big reservoir up to 6,000,000,000 gallons. This will necessitate the laying of a pipe line 35 miles in length. The pipes are to be of steel and 33in. in diameter, lined ¼in. thick with cement mortar. When the expenditure on the whole work, which includes the raising of the wall of the dam by 40ft., amounting to over £1,000,000, has been sanctioned by the ratepayers, the tenders for the pipes and other material will be called for.

The preliminary arrangements in connection with the regular publication of the *Journal of Scientific Instruments* have now been made by the Institute of Physics in co-operation with the National Physical Laboratory. The special attention of those workers who have new designs for instruments is called to the fact that the *Journal* is to serve as a medium of publication of detailed descriptions and critical surveys of the behaviour of such instruments. Original papers or laboratory and workshop notes dealing with the practical or theoretical aspects of scientific instruments should be sent to the editor, Dr. John S. Sanderson, the National Physical Laboratory, Teddington, Middlesex.

For the first time in Great Britain, states *Industrial Gases*, an installation of neon lighting is now being applied outside the London Coliseum. The apparatus is one of the most interesting evolved since the introduction of electric lighting. Neon lighting is carried out by means of glass tubes bent to any desired shape, from which the air has been exhausted and replaced by a small quantity of pure neon gas at a pressure very much below ordinary atmospheric pressure. This neon gas is rendered incandescent by the passage of a high voltage alternating current, passing between two metal electrodes fitted at the ends of the tube, the colour of the incandescent gas being a peculiarly rich form of flame colour. By means of a rotary converter the direct current supplied from the street mains is converted to the alternating current required. In spite of the brilliant illuminating effect obtained on the Coliseum tower—which is a sort of beacon in Central London—it is said that the current consumption is comparatively small.

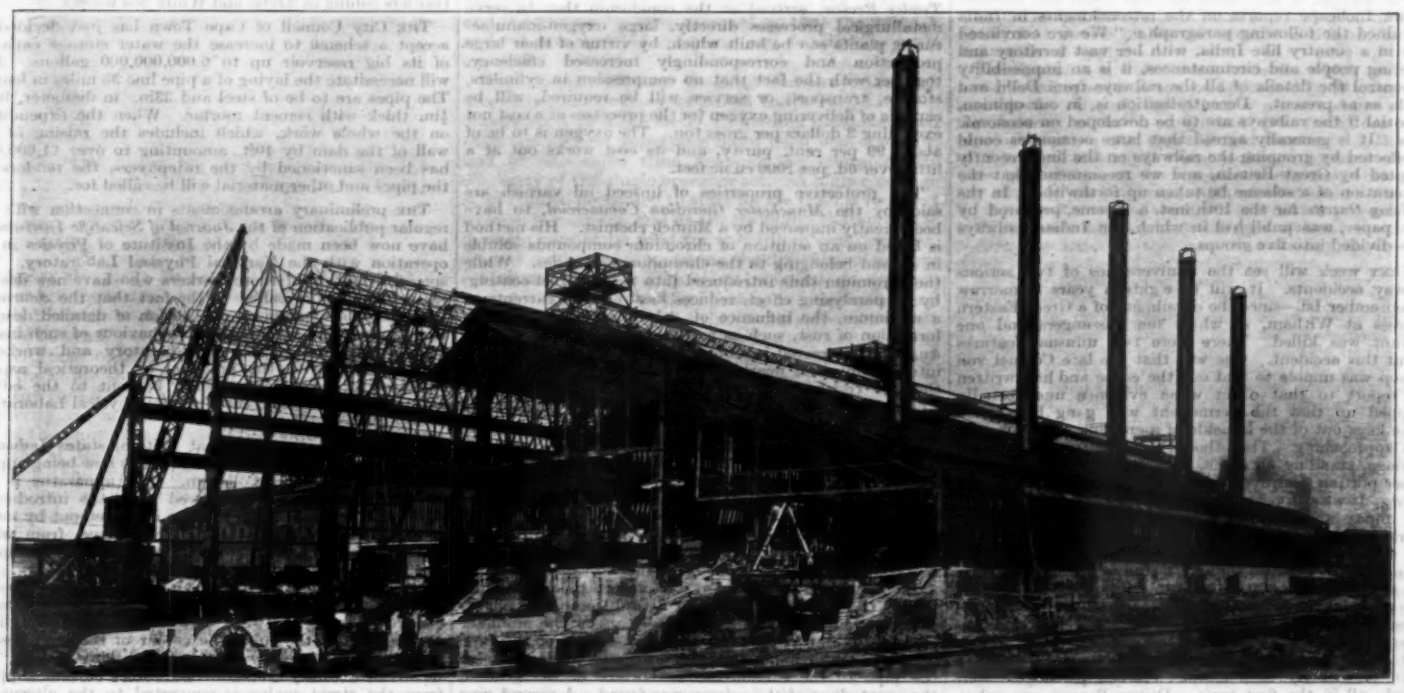
CLYDEBRIDGE STEEL WORKS—NEW MELTING SHOP

(*For description see page 218*)



BUILDING OPERATIONS IN THE EARLY STAGE—MAY 1st, 1917

ERECTION OF STEEL STRUCTURAL WORK—JULY 3rd, 1917



THE FIRST FURNACES STARTED—APRIL 2nd, 1918

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES —MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA —KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT —CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE —BOYVEAU AND CHEVILLET, Rue de la Banque, Paris. CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM —W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA —A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.
ITALY —MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umberto I, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN —MARUZEN CO., Tokyo and Yokohama.
AFRICA —WM. DAWSON AND SONS, Limited, 7, Sea-street (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386-389, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.
CEYLON.—WIJAYARTNA AND CO., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—BRITISH AND COLONIAL PRESS, Inc., 736, The Knickerbocker Building, 152, West 42nd-street, New York City.
FRANCE.—AGENCE VOX, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.		THICK PAPER COPIES.	
Half-yearly	£1 11s. 6d.	Half-yearly.. ..	£1 18s. 9d.
Yearly	£3 3s. 0d.	Yearly..	£3 7s. 6d.
		(The difference to cover extra postage.)	

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition.. .. £3 3s. 0d. „

*** READING CASES, to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

**** The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** With this week's number is issued as a Supplement a Two-page Plate illustrating the Clydebridge Steelworks at Cambuslang of David Colville and Sons, Limited. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

*** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, August 31st, 1923.	PAGE
A SEVEN-DAY JOURNAL	217
CLYDEBRIDGE STEEL WORKS. No. I. (Illus.)	218
THE COMBINED USE OF STEAM FOR POWER AND OTHER PURPOSES. (Illus.)	220
THE ADVANTAGES OF POWDERED COAL AS A FUEL	222
LIFEBOAT FLOODING EXPERIMENTS. (Illus.)	223
TRANSMITTING ELECTRICAL ENERGY FROM NORWAY TO DENMARK	223
LETTERS TO THE EDITOR—	
Payment by Results	223
Empire Development and Employment	223
Annealing	223
Short Histories of Famous Firms—Sharp, Stewart and Co., Ltd.	223
THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION. No. I. (Illus.)	224
SPOTLIGHT	226
RAILWAY MATTERS	227
NOTES AND MEMORANDA	227
MISCELLANEA	227
LEADING ARTICLES—	
Automatic Couplings for Railway Wagons	229
Marine Engineers and Oil Engine Certificates	229
OBITUARY—	
Hertha Ayrton	230
VISIT OF AMERICAN FOUNDRYMEN	230
SIXTY YEARS AGO	230
BOOKS RECEIVED	230
SHORT HISTORIES OF FAMOUS FIRMS. No. XVII.—	
Sharp, Stewart and Co., Limited. No. II. (Illus.)	231
THEORIES AND HYPOTHESES	232
ELECTRICITY IN MINES. No. VI. (Illus.)	234
THE ATLANTIC TRANSPORT LINER MINNEWASKA. (Illus.)	235
TANK ENGINES OF THE PARIS-ORLEANS RAILWAY. (Illus.)	236
AGRICULTURAL IMPLEMENTS IN INDIA	236
MACHINE FOR CROSS-CUTTING AND ROUNDING TIMBER. (Illus.)	236
AMERICAN ENGINEERING NEWS	237
MOTOR TRIALS IN RUSSIA	237
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	237
Lancashire—Sheffield	238
North of England—Scotland—Wales and Adjoining Counties	239
CURRENT PRICES FOR METALS AND FUELS	240
FRENCH ENGINEERING NOTES	241
BRITISH PATENT SPECIFICATIONS. (Illus.)	241
FORTHCOMING ENGAGEMENTS	242
EDUCATIONAL INTELLIGENCE	242
PERSONAL AND BUSINESS ANNOUNCEMENTS	242

TWO-PAGE SUPPLEMENT—THE CLYDEBRIDGE STEEL WORKS AT CAMBUSLANG OF DAVID COLVILLE AND SONS, LTD.

THE ENGINEER.

AUGUST 31, 1923.

Automatic Couplings for Railway Wagons.

ACCORDING to a cable message dated August 9th from the Simla correspondent of *The Times*, the question of adopting automatic couplings on the wagons on the Indian broad-gauge railways has been advanced a further step by the recommendation of a committee reporting to the Chairman of the Railway Board that such provision would be advantageous. Although the question of fitting automatic couples to railway rolling stock was at one time much to the fore in this country, little has been heard of it of recent years, but in view of the action that will probably be taken in India, a survey of the subject at the present time may be of interest. In discussing the matter, it will be helpful to note some points in the history of automatic couplings in America. Mechanical couplings were introduced there as a matter of necessity. Central buffers had practically always been used there, and the cars were connected together by a link-and-pin arrangement. There was never the space between adjoining cars that is to be found on British railways, nor, therefore, the same amount of room for a shunter to stand in. When the cars, in the ordinary course of events, became heavier, the danger to the men inserting or withdrawing the coupling pin became greater. Furthermore, when continuous brakes were fitted the trains could be increased in length, and the link and pin then became insufficiently strong to bear the stresses created by the heavier weights. In addition to these conditions, there were those arising out of the frost and snow experienced to a severe degree in all but the southern states. It was in 1873—fifty years ago—that the Master Car Builders' Association took the first step towards reducing the number of accidents when coupling and uncoupling cars which eventually led to the recommendation in 1887 that the Janney coupling be used. Its design was soon after altered, and became, in 1890, what is now known as the M.C.B. pattern. In 1893, when the Safety Appliances Act was passed, 2727 men were killed and 31,729 injured whilst coupling or uncoupling cars. During the year 1920—the latest return we have at hand—the numbers were 185 killed and 3040 injured.

Neither in India nor in the United Kingdom have matters reached such a terrible state as that revealed by the figures we have just quoted. In the former country, during the year 1921–22, with 754,478 servants, as compared with about 1,700,000 on the railways of the United States, there were 29 killed and 109 injured, whilst in Great Britain, with 678,105 servants, there were only five killed and 331 injured. In India the advantages to be obtained from a central coupling were, to quote the Railway Administration report for 1919–20, an increase in the strength of the coupling permissible, a saving in time of wagon movements, and increased safety for the shunting staff. There were, however, other factors not named in the report that called for the adoption of central automatic couplings. One was the heavier freight wagon that has been adopted on the broad-gauge lines, which brings the average carrying capacity of wagons to over 21 tons. There has also been a more or less general adoption of the bogie freight cars, both covered and open, of which the Great Indian Peninsula had no less than 1261 out of a total of 2245 at the end of the financial year 1921–22. But the main factor has been the use of the vacuum continuous brake for freight trains, which has given the driver much greater command over his train when descending heavy gradients, with the results that the use of more powerful locomotives has been made practicable, that heavier trains have been used, and that the necessity for stronger couplings has arisen. The problem, as it specially related to Indian railways, was discussed at length on page 240 of THE ENGINEER of March 2nd last, when it was explained that the desire of the broad-gauge railways was to have 3000-ton trains, but that the present screw couplings failed by hundreds with trains of 1400–1500 tons. Two illustrations which accompanied the article showed a mechanical coupling fitted in a self-contained "drag" box under the ordinary draw-gear—an arrangement devised to meet the transition stage when screw couplings and mechanical couplings would be on adjoining wagons. In an interesting letter from a correspondent, which appeared in our issue of April 27th, it was asserted that this proposal was not a happy one. The mechanical coupling would, it was alleged, increase the weight of the vehicle, the coupling would be more complicated and therefore more dangerous; while the placing of the coupling on the centre line would cause the buffing and draw-bar stresses to be applied below the headstock. There was also the fact that four-wheeled wagons with side buffers are constructed to have the stresses taken by the two side longitudinal members. That these difficulties were appreciated by the authorities in India can be seen by the reference to them in the Administration Report for the year 1921–22, in which it is remarked that "the difficulty is, of course, in the transition stage, when stock, having two different types of couplings, must simultaneously be utilised."

Coming now to consider how this matter stands in our own country, it is at once obvious that the conditions here are very dissimilar from those of America or India. It is true that we have snow and ice at times, but, as compared with the northern states of America and Canada, the climatic conditions may be ignored. We have little high-capacity stock, and the big bogie wagon is hardly likely to be adopted except for mineral and similar traffic. In addition to these differences, the British wagon has the three-link coupling which, with the coupling pole, is taken off and put on the draw-bar hook as quickly as vehicles are connected together by means of mechanical couplings. Thus there is not, at present, the same need for automatic couplings for freight stock in this country that there was in America and still is in India. The need will, however, nearly certainly arise ere long. Continuous brakes for freight trains have become recognised as desirable in the interests of safe working and for quicker transportation. With them will come the practicability of employing heavier trains, and that will call for stronger couplings. A disturbing factor in the problem is that nearly one-half of the wagons running on British railways belong to private owners, but there is no mechanical difficulty in the way of automatic couplings being attached to the British wagon. It is, like the Indian vehicles, built to allow for the stresses being taken by the side members, but it is possible to meet that and other structural difficulties. It remains, in fact, as Sir Arthur Yorke said in a report on the question in 1907, a financial rather than an engineering matter.

Marine Engineers and Oil Engine Certificates.

IT is a common practice of shipowners, when they decide to acquire a motor ship, to send their engineers to the works of the engine builders to study the engines during the building stages, and often to take a few trips in vessels already equipped with the same type of engines. Nevertheless, there is, apparently, considerable reluctance on the part of the majority of engineers who have already served their qualifying period in motor

ships to submit themselves for the Board of Trade examinations. In 1921 the authorities granted an extension of two years during which engineers employed in motor ships have been exempt from the qualifying examination. This period expires early in the New Year. If, before then, no further modification is made, and if the possession of the oil engine certificate be strictly enforced, it is certain that a difficult situation will arise, because there will be a serious insufficiency of engineers qualified to staff the increasing fleet of oil-engined ships.

To a certain extent the position has been brought about by the fact that a number of the best and most enterprising of the engineers who have qualified in motor ships and have obtained the Board of Trade oil engine certificates, have forsaken sea-going for more attractive, and often more remunerative, positions ashore, sometimes as surveyors to the Registration Societies, or as experts in the service of engine builders. But it is not easy, if, indeed, it is at all possible, to ascertain and co-ordinate the reasons underlying the present dearth of candidates for examination, owing to the very nature of the mercantile service, which necessitates prolonged absence at sea of the engineers in question. If we consider the existing methods by which sea-going engineers engaged in steamships have obtained their Board of Trade certificates, it would seem that the majority have availed themselves of the course of training afforded by the private coaches and schools which are to be found in the large seaports of this country, staffed by ex-sea-going engineers possessing the extra-chief engineer's certificate and with proved ability for teaching. Given a normal share of intelligence, a young engineer in the hands of these coaches finds no great difficulty in rapidly acquiring the knowledge and ability called for in the Board of Trade examinations. The feature to be noted here is that the whole range of theoretical and practical knowledge of marine steam engineering is such that the candidate finds his course of study set forth in a clear and orderly syllabus, which lends itself to rapid and accurate assimilation. With the exception of a few latter-day controversial problems, as, for example, those associated with boiler and condenser corrosion, turbine gearing, and the different systems of oil fuel burning, we may fairly state that what the steam engineer is called upon to acquire is exact knowledge. In other words, due application, and the use of reason and memory suffice to equip him for the test; he passes or fails according to whether he has or has not covered the whole ground of a fixed and definite syllabus. When, now, we consider the position with regard to the oil engine, it is obviously much less simple. The period of the practical application of the oil engine is now about ten years, yet there are very few engineers who have had half that length of experience in the running of motor ships. It is for this reason, no doubt, that, so far, the coaching organisations include no fully qualified motor engineers. Even when this deficiency is, at length, removed by the accession of a few motor-certificated engineers to the teaching staffs, their experience will have been necessarily limited to one or two of the numerous types of engine now being built. It may even be assumed that such an engineer will be an apostle of either the two-cycle or the four-cycle engine, and we know the divergence of views which prevails on this question of the cycles alone, not to mention many other differences in design and working principle of the heavy oil engine. Even in the earliest days of the marine steam engine we find no parallel with such diversity of opinion and practice. It is not difficult, therefore, to understand the delay on the part of those at the Board of Trade who are responsible for the scope of the tests applied to candidates for the oil engine certificates. Nor is it strange that so many of the present engineers in motor ships are not keen to submit what they may feel to be their limited knowledge to the searchlight of the official examination. No doubt this reluctance is unwarranted in view of the latitude which the examiners must, of necessity, allow. What seems to be desirable, in our opinion, is a more definite syllabus explaining the scope of the examinations, and enabling would-be candidates to combine a knowledge of the essential parts of the theory of the oil engine with a thorough familiarity with the practical working and maintenance of some one leading type of engine as a standard qualification for the charge of marine oil engine machinery in general. In the course of time the syllabus might be modified so as to embrace wider knowledge when the present evolutionary phase has given way to one of more exact data and co-ordinated practice.

With the end of the two years of grace already in sight, and with no pronounced increase in the numbers of engineers capable of taking the Board of Trade certificate visible, it became obvious that steps would have to be taken to avoid the awkward position that would occur did the Board of Trade firmly adhere to its decision to enforce the rule from January next. Consequently the Mercantile Marine Department convened a meeting on Wednesday last to discuss the conditions under which certificates will be issued to sea-going engineers in motor ships. At this meeting the representatives of the Board heard arguments concerning the rules, and in due course the decision of the Board will be announced. Owing to the present condition of affairs it is obvious that a further extension of time must be given, and it may be hoped that the Board will find it possible to suggest some transitional method which may be put in force until the position of the marine oil engine is further stabilised.

Obituary.

HERTHA AYRTON.

By the death of Mrs. Ayrton, the widow of the late Professor Ayrton, the Institution of Electrical Engineers has lost its only lady member. Mrs. Ayrton was born at Portsea, of Jewish parents. At the age of sixteen she left school and commenced to earn her living by teaching. Subsequently, she entered Girton College, Cambridge, where she took honours in mathematics. Whilst at college she invented and constructed a sphygmograph for recording the beats of the pulse. Upon her return to London, Mrs. Ayrton took out a patent for an instrument for rapidly dividing up a line into a number of equal parts. In 1884 she became interested in electricity, and in the autumn of that year she entered the Finsbury Technical College as a special student, and it was there that she met Professor Ayrton. In 1893 she assisted in the completion of a series of experiments on the electric arc during Professor Ayrton's absence in America. These and researches on the electric arc were afterwards described in a series of articles appearing in the *Electrician* during 1895 and 1896. The articles, together with accounts of further researches, were also published in the form of a book, which contains amplified accounts of the papers on the arc read by Mrs. Ayrton at the British Association meetings in 1895, 1897 and 1898; on "The Hissing of the Electric Arc," read by her before the Institution of Electrical Engineers in March, 1899; and other papers read elsewhere. Mrs. Ayrton was nominated for a Fellowship of the Royal Society in 1902, but as a woman could not be elected, she was awarded the Hughes Medal by the Society in 1906. Her last appearance at the Institution of Electrical Engineers was on December 14th of last year, when she took part in the discussion on Mr. J. Caldwell's paper, "Electric Arc Welding Apparatus and Equipment." During the war she invented a device for dispersing poisonous gas.

Visit of American Foundrymen.

In connection with the visit of American foundrymen to this country *en route* to Paris for the International Foundry Conference, which is being held there from September 12th to 15th, a dinner was given at the Hotel Cecil on Monday, August 27th, by the London Branch of the Institution of British Foundrymen and the Iron and Steel Institute. Mr. Wesley Lambert, President of the London Branch of the Institution of British Foundrymen, presided, and among those present were Sir Robert Hadfield, Mr. G. H. Clamer—President of the American Foundrymen's Association—and the remainder of the delegation from America, together with members of the two societies, whose guests the American delegates are whilst in this country. Visits are to be paid to Manchester, Sheffield and Birmingham, and to the Shipping, Engineering and Machinery Exhibition at Olympia. The entertainment of the American visitors in this country is the outcome of a desire on the part of British foundrymen, who have received lavish hospitality in America at the hands of American foundrymen on previous occasions, to do something by way of a return compliment, and the opportunity of the Americans' visit to Paris was seized upon for this purpose.

After dinner Sir Robert Hadfield, in proposing "The American Foundrymen's Association," instanced the work done by Mr. Clamer, President of that Association, in connection with the science of metallurgy and foundry. Dr. Moldenke's name, too, was a household word, not only in America but throughout the world, on foundry questions, for he was one of the first to see the great importance and necessity of applying science to foundry practice. Others to whom Sir Robert referred were Mr. Stanley Flagg, a Past-President of the Association and also Chairman of the Committee on International Relations of the Association, and Mr. Walter Wood, the head of the Committee of the Association which dealt with international specifications for cast iron. Referring to the Institution of British Foundrymen, Sir Robert said the membership was now 1500, which was a very good record for a society which had not been established very long.

The toast was supported by Engineer Vice-Admiral Sir George Goodwin.

Mr. G. H. Clamer—President of the American Foundrymen's Association—said the time when business men cherished secrets and carefully secluded and jealously guarded their processes of production, had passed. Co-operation had avoided wasteful competition, and efficiency had been increased by the more confidential relations between employers and employees. A nation was nothing else than a business organisation. Its prime obligation was so to organise and relate its productive capacity as to ensure to each individual a proper return for his effort. As individual businesses had learned from experience the benefits of unselfish co-operation, so the nations of the world were beginning to realise that industrial progress depends upon international co-operation. Commercial rivalry in the world market must be as open as competition in the home market. The same principles must be adopted to secure national efficiency as were employed by the individual. A new epoch was opening in the industrial history of the world in which a better understanding among commercial nations and the desire to do away with national egotism was rapidly growing. The invitation to inspect British foundries was one of the ways in which the foundrymen of Great Britain were earnestly endeavouring to establish a means for the exchange of ideas relating to the metal industries. It was the hope of American foundrymen that the next international conference would be held in America, and that American foundrymen would then have the opportunity and great pleasure of entertaining a large delegation of members from both the Institution of British Foundrymen and the Iron and Steel Institute and other technical organisations connected with the foundry industry.

SIXTY YEARS AGO.

In 1863 the president of the British Association was Sir W. G. Armstrong, and in our issue of August 28th for that year we reprinted his inaugural address. Unlike modern presidents, most of whom deal with the particular subject in which they are chiefly interested, Sir William reviewed the outstanding features of recent scientific progress in a variety of branches, a procedure possible in those days, but scarcely to be attempted by any one individual to-day. We have been greatly struck in reading his address by the clarity of his expression and the grasp he displayed of subjects outside his every-day interest. As a philosopher we find him musing over the development of invention and coming to the conclusion that in the intellectual world fitness of time and circumstance promptly calls forth appropriate devices. "The seeds of invention," he remarked, "exist, as it were, in the air, ready to germinate whenever suitable conditions arise and no legislative interference is needed to insure their growth in proper season." On the subject of our coal supplies, he expressed anxiety in connection with their exhaustion. He did not appear to grasp the significance of the rapidly rising export of "petroleum oil" from the United States, an export which, according to another article in the same issue, had increased from 3250 barrels in the first half of 1861 to 425,000 barrels in the same period of 1863. But he clearly foresaw modern hydraulic power developments. The rivers of the Alps, he said, would, with artificial works to impound and regulate the supply, yield thousands of horse-power and, he continued, there was at least one great river in the world which in a single plunge developed sufficient power to carry on all the manufacturing operations of mankind if concentrated in its neighbourhood. This reference was probably to the Niagara Falls, although it may have been to the Victoria Falls on the Zambesi, which Livingstone had then quite recently discovered. From these subjects he passed in turn to astronomy, meteorology, revised spelling, weights and measures, African exploration and Darwin's recently published work promulgating the doctrine of natural selection.

BOOKS RECEIVED.

London Shipping, Who's Who? 1923. Published by the *Journal of Commerce*, Liverpool. Price 2s. net.

Scottish Shipping, Who's Who? 1923. Published by the *Journal of Commerce*, Liverpool. Price 2s. net.

Liverpool Shipping, Who's Who? 1923. Published by the *Journal of Commerce*, Liverpool. Price 2s. net.

North-East Coast Shipping, Who's Who? 1923. Published by the *Journal of Commerce*, Liverpool. Price 2s. net.

Small Electric Lighting Sets. By C. F. Caunter. Glasgow: James Munro and Co., Limited, 35, Washington-street. Price 3s. 6d. net.

Chemistry as a Career. A Synopsis of Lectures given by the Registrar before College Chemical Societies during 1921–1923. London: Institute of Chemistry of Great Britain and Ireland, 30, Russell-square, W.C. 1.

City and Guilds of London Institute, Department of Technology: Programme for the Session 1923–1924. Containing general regulations and syllabuses for examinations in technological subjects and for Teachers' Certificates. London: John Murray, Albemarle-street, W. 1. Price 3s. 6d. net.

Continuous Brakes on Goods Trains.—We are asked to state in connection with an article under the heading given above, which appeared in our issue of August 24th, that compressed air brakes are used solely on freight trains in the United States, and that the Governments of France, Belgium, and Italy have selected the Westinghouse brake for recommendation to the Berne Conference as the standard freight brake for European rolling stock.

Short Histories of Famous Firms.

No. XVII.

SHARP, STEWART AND CO., LIMITED, ORIGINALLY OF MANCHESTER, LATER OF GLASGOW.

No. II.*

No account of Sharp, Stewart and Co. would be complete without mention of the firm's connection with the introduction of the injector† into this country in 1860. One account stated that Mr. Stewart saw Giffard's injector at work on a French steamboat, and secured the patent rights in this country for his firm. But another and a much better story is related in the excellent book on "The Practice and Theory of the Injector," by Kneass, an American writer. According to this author, very shortly after Giffard had produced his invention, two sample injectors were obtained by the French representatives of Sharp, Stewart and Co. and of another British firm of locomotive builders, who sent them over to their respective firms. No instructions appear to have been available or sent, and it remained for the two firms to do their best with a totally strange appliance. One of Messrs. Sharp's engineers, by good luck, coupled up the correct pipes to their proper flanges, and got up steam. After waiting to see what would happen, he found to his astonishment that water was being fed into the boiler. The head of the firm came round, saw the injector at work, and immediately secured the sole rights for its manufacture in this country. Unfortunately for the rival firm it connected up its sample injector incorrectly, and could not get it to work. There were many difficulties in overcoming the prejudice attending its introduction, and one assistant railway engineer, in order to get the driver to use it, had surreptitiously to remove the suction clack valves from the feed pumps. The driver reported: "Pumps out of order, and could not have got along without the new injector." It was added that although the assistant engineer proved the success of the new appliance, he got into trouble for removing the pump clacks.

A type of 2–4–0 inside cylinder passenger engine developed‡ by the firm from 1861 onwards was that in which the bearings of all the wheels were inside, and this type was shortly afterwards adopted by Mr. Ramsbottom on the London and North-Western Railway and subsequently by Mr. Webb. Most of Sharp-Stewart's earlier engines of this class were of small size for branch railways, and for many years the Cambrian and Furness railways employed no others. These, which had 5ft. 6in. coupled wheels and 16in. by 20in. cylinders, together with the corresponding standard goods engines with 4ft. 6in. wheels and 16in. by 24in. cylinders were illustrated in THE ENGINEER, February 1st, 1895. The goods engines were built continuously from 1863 until 1884, with only a few minor alterations from the original design.

In 1861 the firm laid the foundation of what afterwards proved to be an extensive South American trade by the construction of an engine for the Sao Paulo Railway, Brazil. The first engine built by the firm for Argentina followed in 1864.

The well known 0–6–0 goods engine "Manchester," which was on view at the London Exhibition of 1862, was an excellent example of the firm's design and workmanship. It was illustrated in Colburn's "Locomotive Engineering"—Plate 5—and need not be described at great length. It had double frames, 5ft. wheels, 17in. by 24in. cylinders, Cudworth's patented fire-box, and carried 120 lb. pressure. Unlike the earlier engines—Fig. 6—the inside frames were carried through to the back buffer beam, instead of being fastened to the front of the fire-box casing. This greatly improved design for double framed engines was, the writer believes, first originated by Sharp, Stewart and Co. The "Manchester" was purchased for the Egyptian Government Railways, and the writer saw it broken up at Cairo in October, 1895, with the original boiler, which had done continuous service for thirty-three years.

One of the earliest eight-wheels coupled engines built in this country, and the first by the firm, was made in 1865 for an Indian railway. This engine which was of unique design, was illustrated in THE ENGINEER of February 1st, 1895. It had inside cylinders, the connecting-rods driving a "dummy" crank shaft after the manner of the "Carrett" tank engines made by E. B. Wilson and Co. The outside cranks of this shaft were coupled to two axles in front of and two behind the shaft. The springs, which were about 5ft. long, consisted of a number of plates of equal length, and were placed in an inverted position above the axle-boxes. There were no slide bars; the long forked connecting-rods were attached to crossheads placed near the middle of the long hollow piston-rods. The back ends of these rods worked in circular guides attached to the motion plate. This form of motion was introduced by the firm about 1856, and an illustration of it is to be found in "Recent Practice in the Locomotive Engine," by D. K. Clark and Z. Colburn—1860—Plate 43.

The eight-wheels coupled saddle tank engine—Fig. 7—was one of six built in 1866 for the Mauritius Railways, on which there are very steep gradients. The coupled wheels are 4ft. diameter, and the cylinders 18in. by 24in. The wheel base was 4ft. 2in. + 6ft. 2½in. + 5ft. 1½in. = 15ft. 6in. The total heating surface was 1191 square feet, and the weight 46 tons 2 cwt. in working order.

As examples of good workmanship and construction may be instanced twenty six-wheels coupled goods engines built by the firm in 1867–8 for the Midland Railway to Mr. Matthew Kirtley's design, eighteen of which are still at work and doing good service with the original frames and much of the

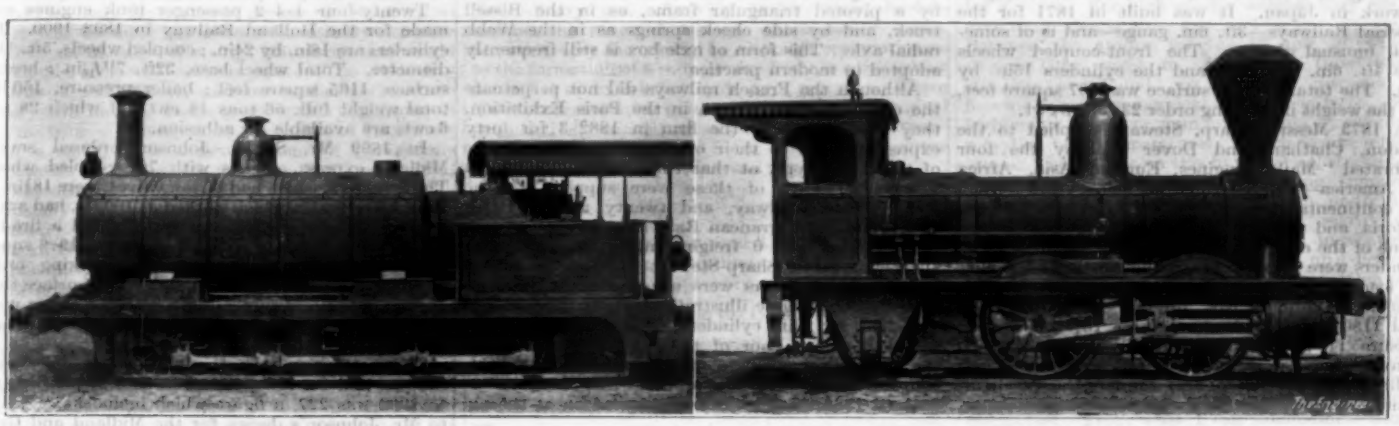


FIG. 7—EIGHT-COUPLED TANK ENGINE, MAURITIUS RAILWAYS, 1867

FIG. 8—PASSENGER ENGINE, IMPERIAL JAPANESE RAILWAYS, 1871

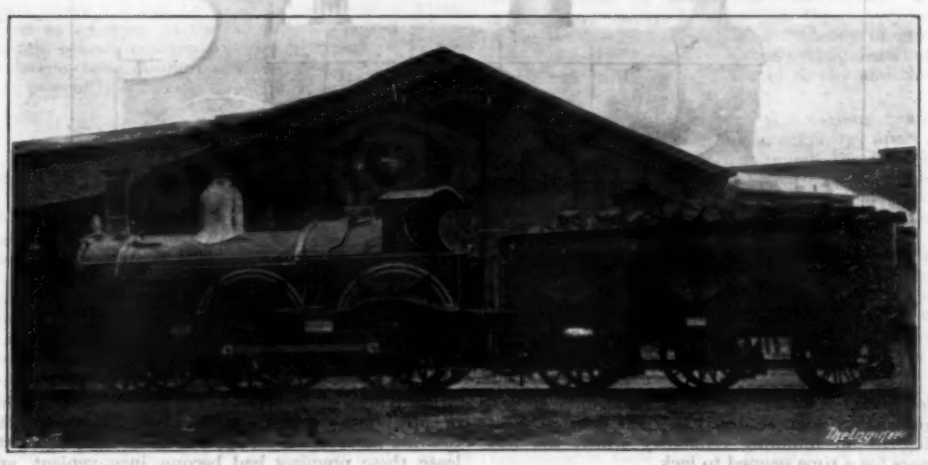


FIG. 9—FOUR-COUPLED EXPRESS ENGINE, LONDON, CHATHAM AND DOVER RAILWAY, 1873

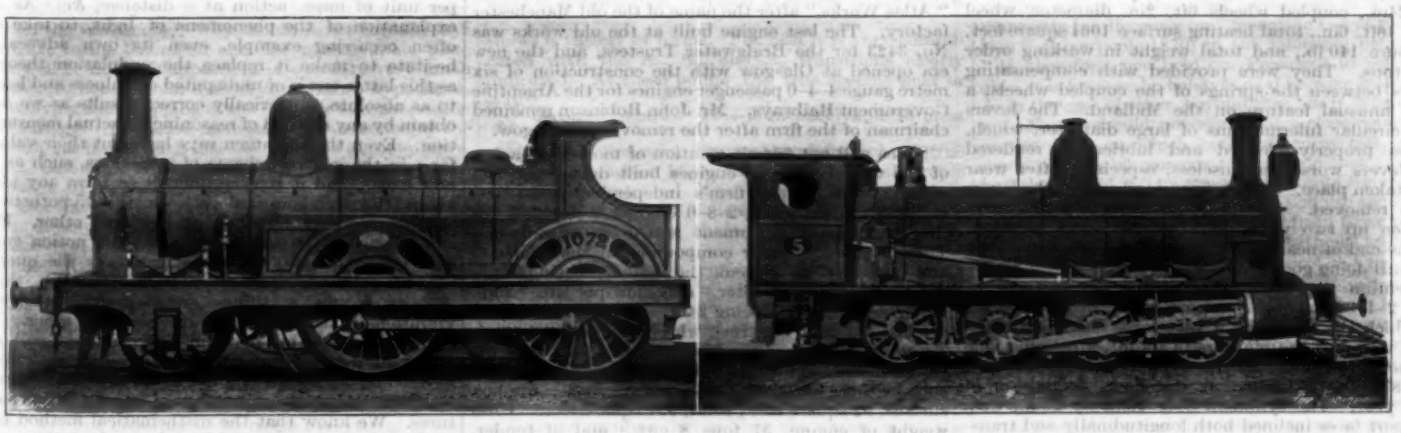


FIG. 10—EXPRESS PASSENGER ENGINE, MIDLAND RAILWAY, 1874

FIG. 11—EIGHT-COUPLED GOODS ENGINE, BARRY RAILWAY, 1886

* No. I. appeared August 24th.

† The late Mr. James Gresham, afterwards of Gresham and Craven, Limited, Manchester, was placed in charge of the injector department of Sharp, Stewart and Co., and many of the improvements in the appliance were made by him.

‡ The type was originated in 1842 by Messrs. R. Stephenson and Co., in their "long boiler" 2–4–0 goods engines.

old motion. Another instance of thirty 2–4–0 passenger engines, built in 1867–1870 for the Great Eastern Railway to the designs of Mr. S. W. Johnson, when he was chief locomotive superintendent of that line, may also be mentioned. These engines were employed on long-distance cross-country services, and were of comparatively small size, with 5ft. 7in. coupled wheels, and 16in. by 22in. cylinders. The first of them to be built in 1867 was the last to be broken up at the end of 1913 after more than forty-six years' continuous service, and several of the others had only a little less service to their credit.

The two thousandth locomotive built by the firm, a goods engine for one of the Russian main line railways, was completed in 1870.

In Fig. 8 is illustrated the first tender engine to work in Japan. It was built in 1871 for the Imperial Railways—3ft. 6in. gauge—and is of somewhat unusual design. The front-coupled wheels were 4ft. 6in. diameter, and the cylinders 15in. by 22in. The total heating surface was 807 square feet, and the weight in working order 23 tons 8 cwt.

In 1873 Messrs. Sharp, Stewart supplied to the London, Chatham and Dover Railway the four celebrated "Mail" engines, Europa, Asia, Africa and America—Fig. 9—which for many years worked the continental mail and boat expresses between Victoria and Dover, and were the last examples of one of the characteristic designs of the firm. The cylinders were 17in. by 24in. coupled wheels 6ft. 6in., and leading wheels 4ft. 6in. diameter. Tube heating surface 1080 square feet, fire-box 100 square feet, total 1180 square feet. Grate area 16½ square feet, pressure 140 lb., total weight 36½ tons, of which 24 tons 6 cwt. were available for adhesion. Their quality in the matter of fast running was excellent, so much so that when they were subsequently superseded on the "mails" by heavier and more modern engines, they soon returned to their original duties owing to an unfailing reliability which the newcomers for a time seemed to lack.

The engines in Fig. 10 are of interest, in that they were the last passenger engines designed by Mr. Matthew Kirtley for the Midland Railway, though they were delivered in 1874 after Mr. S. W. Johnson, who made a few minor alterations in the details, had taken charge. The cylinders were 17in. by 24in., coupled wheels 6ft. 2in. diameter, wheel base 16ft. 6in., total heating surface 1061 square feet, pressure 140 lb., and total weight in working order 35½ tons. They were provided with compensating levers between the springs of the coupled wheels, a very unusual feature on the Midland. The levers had circular fulcrum pins of large diameter, which, unless properly cleaned and lubricated, rendered the levers worse than useless, especially after wear had taken place. After a few years' service the levers were removed. One of these twenty engines was broken up two years ago, but the other nineteen, at the end of nearly forty-nine years' constant work, are still doing good service.

Mention has been made of the development of the 2–4–0 passenger engine with inside frames, in which the firm took a very large share, although they were not the pioneers in its introduction. One of the last examples of this type—Fig. 12—was built in 1878 and exhibited at the Paris Exhibition of that year. The cylinders were 18in. by 25in., with the port faces inclined both longitudinally and transversely, as in the London and North-Western "Precedent" class. The coupled wheels were 6ft. 6in., and the leading wheels 4ft. diameter, the axle-boxes of the latter being provided with inclined planes allowing ½in. lateral movement on each side of the central position. The slide valves were of the "Trick" type, actuated by Allan's straight link motion. Total heating surface 1238 square feet, weight in working order 35¾ tons. This engine was purchased by the Paris-Orleans Railway, on which it worked main line express trains for several years.

In 1880 the firm inaugurated a new type of engine—the 4–4–2 tank locomotive for passenger service—thirty of which were built for the London, Tilbury and Southend Railway, having 6ft. 1in. coupled wheels and 17in. by 26in. outside cylinders. This type, with leading bogie and radial trailing axle, has since been extensively adopted for home and overseas railways. A few three-cylinder compound engines on Webb's system were constructed in 1884–5. One of these went to the Western Railway of France, one to the Austrian State Railways, and two with leading bogies to the Paulista Railway of Brazil.

Mention may be made here of a radial axle—Bottomley's patent—which was introduced by the firm at this period. The axle-boxes on both sides are connected by a transverse casting, as in the Webb system; but in the Bottomley design this casting is straight instead of curved and does not move in guides. The radial movement is controlled by a pivoted triangular frame, as in the Bissell truck, and by side check springs as in the Webb radial axle. This form of axle-box is still frequently adopted in modern practice.

Although the French railways did not perpetuate the class of engine shown in the Paris Exhibition, they gave orders to the firm in 1882–3 for forty express engines to their own designs. These were of the 2–4–2 type, at that time in great favour in France. Twenty of these were supplied to the Paris-Orleans Railway, and twenty to the Paris, Lyons and Mediterranean Railway.

The heavy 0–8–0 freight engine—Fig. 11—was another typical Sharp-Stewart engine, of which considerable numbers were constructed for railways abroad. The engine illustrated had 4ft. 3in. wheels, and 20in. by 26in. cylinders. The total wheel base was 15ft. 5in. Four of these were purchased by the Barry Railway, and were the first eight-wheels coupled tender engines to work in this country.

Until 1888 the business was carried on at the old Atlas Works in Manchester under the chairmanship of Mr. John Robinson*, who had succeeded Mr. Stewart in 1882. But, apart from the expiry of the lease, these premises had become inconvenient, and the finished products had to be carted to the railways. An arrangemt was, therefore, made with the Clyde Locomotive Works, already established in 1885 at Springburn, Glasgow, by which Messrs. Sharp, Stewart and Co. took over the principal interest in these new works, which were then re-named the "Atlas Works," after the name of the old Manchester factory. The last engine built at the old works was No. 3423 for the Bridgwater Trustees, and the new era opened at Glasgow with the construction of six metre gauge 4–4–0 passenger engines for the Argentine Government Railways. Mr. John Robinson remained chairman of the firm after the removal to Glasgow.

Space will not permit mention of more than a few of the varied types of engines built during the last fifteen years of the firm's independent existence. In 1889 twenty-seven 2–8–0 engines were built for the Argentine Government metre gauge railways. They are two-cylinder compounds on the Worsdell and von Borries system, the cylinders being high-pressure 16in. diameter, and low-pressure 23in. diameter, the stroke being 24in. The coupled wheels are 3ft. 6in. and the truck wheels 2ft. 3in. diameter. Total wheel base, 19ft. 2in., of which the extreme coupled wheels are spaced 12ft. 7in. apart. The tube-heating surface is 845 square feet; fire-box surface, 92 square feet; total, 937 square feet. Total weight of engine, 37 tons 8 cwt.; and of tender, 21 tons 7 cwt.

A handsome 4–4–0 express engine was built in 1892 for the Holland Railway for the heavy express traffic between the Hook of Holland and the German frontier. It was derived from a type designed by Sharp, Stewart and Co. in 1889 for the Dutch Rhenish Railways, and fifty-four of the class were built by the firm between 1889 and 1903. The coupled wheels are 6ft. 7½in. diameter, spaced 9ft. from centre to centre, and the cylinders are 18in. by 26in. The boiler, which has a total heating surface of 1201.3 square feet, is provided with a long fire-box and 23.14 square feet of grate area. The pressure is 150 lb., and the total weight in working order is 45 tons.

A series of 2–8–0 freight engines was built in 1896 for the Sao Paulo Railway, Brazil—5ft. 3in. gauge. These engines have 20in. by 26in. cylinders, 4ft. 6in. coupled wheels, 1497 square feet of heating surface, and carry 175 lb. pressure.

A 4–4–4 tank engine, built in 1897 for the Midland and South-Western Junction Railway, was the second in this country with this symmetrical wheel arrangement, which is still very uncommon. The cylinders are 17in. by 24in., coupled wheels 5ft. 3in. diameter. The coupled wheel base is 7ft. 6in., and the total wheel base 31ft. 7½in. Total weight 59¼ tons. Tank capacity, 1900 gallons.

Twenty-four 4–4–2 passenger tank engines were made for the Holland Railway in 1898–1900. The cylinders are 18in. by 24in.; coupled wheels, 5ft. 1in. diameter. Total wheel base, 32ft. $7^{11}/_{16}$in.; heating surface, 1165 square feet; boiler pressure, 150 lb.; total weight full, 56 tons 18 cwt., of which 28 tons 6 cwt. are available for adhesion.

In 1899 Mr. S. W. Johnson ordered several Midland express engines with 7ft. coupled wheels. The cylinders, which had piston valves, were 18½in. by 26in. The boiler, which worked at 160 lb., had a tube heating surface of 1076 square feet, and a fire-box surface of 117 square feet. Grate area, 19.6 square feet. Total weight of engine in working order, 45 tons. In spite of their small heating surface these engines were very successful in working trains up to 250 tons between Nottingham and London, and also between Nottingham and Leeds.

The total number of engines built by Sharp, Stewart and Co. for the Midland Railway, from 1839 to 1902 was 227, a figure which includes 33 engines to Mr. Johnson's design for the Midland and Great Northern Joint Railway.

The excellent 4–4–0 express engines built in 1901–1903 for the Great Central Railway, to the designs of Mr. J. G. Robinson, were illustrated in THE ENGINEER of July 4th, 1902.

In 1903 Sharp, Stewart and Co. amalgamated with the two other Glasgow locomotive builders, Neilson, Reid and Co., and Dubs and Co., to form the North British Locomotive Company, Limited. It is of interest to note that when the new company was formed the name of Sharp was still connected with the old firm in the person of Mr. John H. Sharp, the grandson of Mr. John Sharp, one of the original founders. Mr. J. H. Sharp was managing director of the Atlas Works until his death in November, 1913. Another member of the firm, Mr. J. F. Robinson, was also a managing director of the North British Locomotive Company, Limited, until his death in 1918. At the time of the amalgamation the total number of locomotives which had been built by the firm at Manchester and Glasgow was 5014.

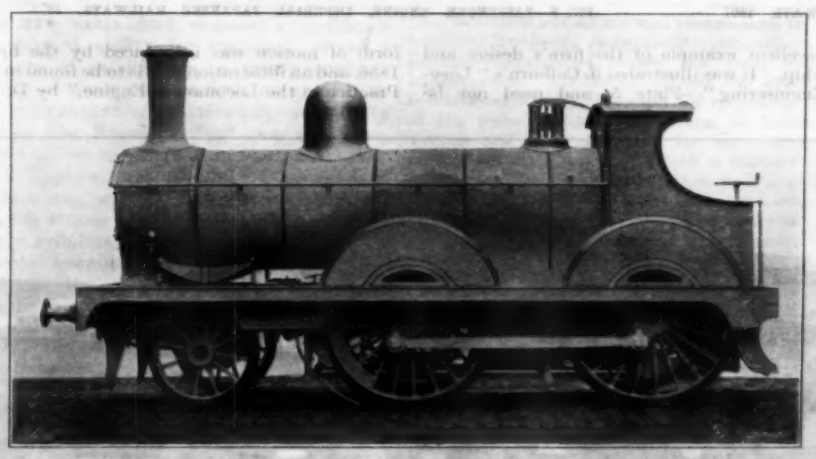


FIG. 12—FOUR-COUPLED EXPRESS ENGINE (P.O. RAILWAY), PARIS EXHIBITION, 1878

* Mr. John Robinson was president of the Institution of Mechanical Engineers in 1878–9.

Theories and Hypotheses.

By JOHN G. A. RHODIN, F.I.C.

SCIENTIFIC development during the last thirty years has been characterised by the reintroduction of the corpuscular theory as a fundamental notion, as it can be applied to certain strange phenomena which have been studied of late—radiology, isotropy, &c.—with a certain amount of ease. The objections of old still hold good, viz., we must assume enormous corpuscular speed, incredible quantities of energy per unit of mass, action at a distance, &c. As an explanation of the phenomena of light, to take an often occurring example, even its own advocates hesitate to make it replace the undulation theory, as this latter one is of undisputed usefulness and leads to as absolute, numerically correct results as we can obtain by any method of reasoning on actual mensuration. Even the Röentgen rays have got their values for λ in the general scheme of radiations, such as it now exists, and it is very difficult to form any idea about the collaboration between the hypothetical electrons and the hypothetical luminous ether. For convenience most investigators use the notion suitable for each case, but there is always the query, whether the streams of electrons through their velocity acquire a stiffness sufficient for transverse vibrations, thus forming our old luminous ether.

Investigations by mathematical analysis will no doubt in time find the means of unification; but meanwhile we are getting more and more bewildered by the ever-increasing number of speculative departures. We know that the mathematical method has made enormous strides of late, but a long time will lapse before this new and powerful vehicle will be a part of the mental equipment of the experimenter. Physics and chemistry have already entered into an indissoluble partnership, and mathematics is gradually dominating both; but the intellectual capacity necessary for obtaining an easy command of the lot is very rare as yet. When we think of the fact that a modern schoolboy, through the improvements in method, very often knows more than, say, Archimedes of old, we can entertain hopes for the future. On the other hand, we have no means of understanding the intellectual efforts which led the same Archimedes to his results. He had no system of numbers like

ours, and the arithmetical method was then laborious in the extreme, and still he got a decent approximation of π, &c. As a matter of fact, he solved problems by the method of infinitely diminishing differences, and thus used calculus without knowing it, his quadrature of the parabolic segment being the most brilliant example.

We may to-day have many similar great minds, and it is to be hoped that some of them will tackle the problem of unity of scientific theory, so as to make other minds less bewildered. The nearest approach to satisfaction was given in the doctrine of conservation of energy during the middle of last century. I still believe that we must accept that doctrine as a central notion; but it is said that Lord Kelvin himself was rather doubtful about it towards the end. Should we deny the notion as necessary, the practical effect will be nil; but all our beautifully accurate predictions in cases of energy transformation would be simply accidental coincidences! The absurdity of this is self-evident, and no doubt the electron theory will have to range itself within the frame of the doctrine of conservation of energy, or once more take a rest. It is a development of the atomic hypothesis of Democritos which, in the form applied to chemistry, is extremely useful, though philosophically impossible. The electron introduces the necessary divisibility of the atom, but makes it numerically limited; hence introducing another indivisibilium, which is also logically unthinkable. With a free hand to determine the number, speed, and total energy of the electrons in an atom, you can prove anything; but some of us at least would like to see a reasonable release of atomic energy before accepting it as existing with the order of magnitude ascribed to it. Apart from this, one would like to see how atomic energy is to be rendered available for external work. The archaic simplicity of the notion that an atom is made up of particles of ponderable energy which can be released or release themselves without energy dissipation, but, on the contrary, accompanied by amelioration into radiant energy, seems somewhat difficult to swallow. Spreading the effects over some hundreds of thousands of years does, however, make the available energy quantities unreasonably small instead of the reverse, even in the case of radians. The discoveries themselves are highly interesting, and they may lead to industrial wonders like Voltas wire on the fence; but the present theory is not satisfying.

In the above I have supposed the notion to be that atoms are made up of electrons, and the latter thus ponderable. This is supposed to be the latest conception, but the literature is full of statements relating to electrons as distinct from atoms. To the matter-of-fact man light on the point is vital, as parts of an atom must have weight, whereas an electric charge might be, and to most of us is, imponderable. If the conception, electron, is unitary, its manifestations are, all the same, brought about in two diametrically opposite ways, viz., by absorption of energy in the Crookes' tube and accompanied by evolution of energy in the case of radio-active substances. In the former case we have little to complain about, as we can reconcile that with the doctrine of conservation of energy. To make the other case amenable to reason we must suppose that radio-active substances transform some kind of cosmic radiations, which are elusive to our senses and instruments, into the α, β, and γ rays, which we can observe. That the building down of atoms from round about 200 to electrons or even helium at 4 should mean a corresponding expansion with evolution of energy is certainly not acceptable as yet. We know well enough that the invisible solar spectrum is more than ten times longer than the visible one; why should it not contain rays elusive to the bolometer and the photographic plate as well? Such a supposition is certainly very much easier to accept than a theory, or rather hypothesis, involving the scrapping of the doctrine of conservation of energy. The often-mentioned recalescence of the earth itself has such distinct parallels in metallurgy, &c., that there is no necessity for assuming an intercession by radiological phenomena.

Our query is, whether science has not endeavoured to anticipate without a necessary experimental discovery. As yet the practical application of radiology apart from certain medical departures is nil, as the X-rays as such have gained their usefulness just by being ranged in amongst ordinary transversal vibrations of the ether, and through this only have proved useful for ultra-spectrology. There can be no doubt that a gradual simplification of notions will occur without affecting the observed facts relating to isotropic changes, positive and negative electrons, &c. &c, but enabling us to range everything in conformity with the doctrine of conservation of energy. We have in practical electro-magnetism many notions like lines of force, electric intertia, &c. &c., but they do not in the slightest interfere with the making up of a correct balance-sheet of energy quantities, although they are auxiliary conceptions only. The scientific development in theoretical electro-dynamics of late years has, in spite of its rapidity, been of such critical accuracy that nothing parallel can be found in history. Maybe the leaven of practical endeavour maturing the academic investigations at a rapid rate was the cause, as in the case of thermo-dynamics, but the results satisfy the practical mind's demand for balancing *pros* and *cons*—in both cases with extreme accuracy. Our satisfaction is, however, only complete with regard to energy quantities; intensities are, on the other hand, still more or less problematical.

The fundamental notion of temperature has of late developed into the fourth power of the radiation of a "black body" after being the square and third power in succession. Nobody worries about this in practice, as long as our energy quantities are right, from obvious reasons. We can get correct comparative results fairly easily within the ranges of most importance, and it suffices for present demands. For more scientific purposes there is the method of mensuration of intensities in different parts of the spectrum by photometer or bolometer, but one would like to see some kind of standard black body evolved for ordinary use. Arriving at anything absolute beyond the range of the gas thermometer seems, however, very far off as yet, although speculation as to the formation of a radio-active body as a disturbing factor has up to now not made its appearance. There is a rather interesting point with regard to our original definition of temperature as derived from the expansion of an ideal gas, which has always puzzled the writer. We take the volume at t deg. Cent. as

$$V_t = V_0 \frac{273 + t}{273} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Supposing that for the interval 0 deg. to 100 deg. the expansion took place according to the more rational conception (2) $V_t = V_0(1 + \alpha)^t$, and let α remain as $\frac{1}{273}$, we should, according to (1), get

$$V_{100} = V_0\, 1.3663,$$

and, according to (2),

$$V_{100} = V_0\, 1.4410.$$

The order of magnitude of our degrees as generally determined would alter by 7.5 per cent. only, and we should get V_0 as unity wherever we placed our zero. For practical purposes such a change of conception would involve little change at ordinary ranges in numerical results, but the temperature "intensity" would double gradually during a rise of something just above 273 deg. Cent. The coefficient of expansion as referring to the actually measured volume would remain constant at any temperature without reference to an absolute zero in the case of ideal gases. At present it continuously diminishes:—

$$\left.\begin{matrix} V_0 = 1 \\ V_{273} = 2 \end{matrix}\right\} \; V_{273} = V_0\, 2 \qquad \left.\begin{matrix} V_{273} = 2 \\ V_{546} = 3 \end{matrix}\right\} \; V_{546} = V_1\, 1.5$$

&c. &c.

For constant pressure (as supposed) this is the same for various pressures within fairly wide margins, and the masses may be the same at the varying intervals.

All this is highly elementary, but it shows that our present temperature system is bound to a distinct interval, viz., 0 deg. to 100 deg. Cent., and the extrapolation to absolute zero is mathematically impermissible, as it makes V diminish without limit, whilst retaining its mass. We can imagine cessation of heat motion, but disappearance of matter is, at least so far, unthinkable. In the expression (2) V would disappear for $t = -\infty$ only, which is impossible to reach from its definition; but $V_{0\ abs.}$ must be finite, as the function is exponential and not a sum as (1). If we now contemplate heat quantities, these are always estimated in units between 0 deg. and 100 deg. Cent. Preference is given to the ice calorimeter of Bunsen's type by modern investigators of heat contents in ratio to temperature. Plotted as curves $\frac{W}{t}$ for metals shows a variety of forms. For iron it is very complicated with the A_2, A_3, and A_4 transitions clearly indicated. At these points the true specific heat or $\frac{d\,W}{d\,t}$ becomes infinite. This is inconceivable to most people, but the error lies in the definition of true specific heat, which has nothing to do with allotropic changes.

A rational way out would be to subtract the transition heats from the rest at the proper places when constructing the $\frac{W}{t}$ curves, which would thereby become almost continuous. But even then there is a slight change of direction at the points in question which varies the specific heats in both directions. Hence even the quantum theory of Planck and Einstein is inapplicable, as their formula for 'atomic heat : temperature' gives a continuous curve. A still more peculiar fact is that the variation of the specific heat of water between 0 deg. and 100 deg. Cent. is harmonic. The essence of the quantum theory is, according to a recent publication:—"Planck and Einstein assume that a vibrating atom cannot take the energy continuously, but only discontinuously, in definite units (the so-called energy quanta), which are for each atom or vibrating system proportional to the frequency of vibration, i.e., the vibrating atom takes up 'atoms' of energy, so to speak." I have been trying in vain to picture the physical interpretation of this. Are we to imagine a new kind of imponderable corpuscle? Is it the capacity of the substantial atom which increases with temperature, or do the quanta vary? What kind of discontinuity can be represented by the heat frequency multiplied by 4.860×10^{-18}? Does the theory apply to both radiant and conveyed heat? Is the whole thing not merely a brilliant mathematical explanation of the variation of specific (or atomic) heats with temperature to suit observed facts? There is this gained: that we know that heat quantities have a varying value according to the temperature, and that it is not right to draw conclusions as to what happens at very high temperatures by comparisons at 0 deg. Cent.

Why the hypothesis in question should be called a theory is, however, somewhat difficult to understand. There is something highly interesting about the 'atomic heat : temperature' curves thus obtained, viz., they appear to be asymptotic and convergent for $T = \infty$. For high atomic weights they are concave to the temperature axis, and for low ones convex. Between the atomic weights 12 and 20, where a straight line ought to occur, only three gaseous elements are found, viz., oxygen, nitrogen, and fluorine, whatever significance that may have. Somebody might, however, gain immortality by calculating a system of "temperatures" which would make all atomic "heats" lie on this hypothetical straight line, by giving "temperature" a varying significance according to the substance acted upon, or to give it a modern name, by determining its "relativity."

The possibilities of theorising are inexhaustible, and if the present rate of output is kept up a dictionary of theories will soon be found necessary. One of the latest additions is the relativity theory of Einstein. It has the peculiarity that what can be understood is not new, and that what most of us cannot understand is not necessary. The advent will not affect astronomy one iota, nor is anybody going to adopt an ever-obliging space as a fundamental notion in mechanics. From what I can understand, Einstein sought a physical application of certain functions belonging to the new mathematics, and the outcome was this now famous theory. The astronomical "proof" is far from convincing, as this is a case of *tertium datum*. When the moon's shadow passes through the atmosphere all kinds of erratic refraction are thinkable in connection with thermal effects which may easily account for these very small aberrations. To me, this new "theory of gravitation" seems to be similar to the pythagorean notions of old, which the simpler ones of Kepler and Newton put out of existence.

Here I propose to leave the various examples without entering upon the notion of energy apart from mass and speed, &c., and to review the hypotheses as a whole. My main objection to most of them is their negation of continuity of matter, the absolute necessity for which is so well proven by Kant that it can hardly be disputed. One cannot very well suppose the balls of a steam engine governor to act without being connected to the spindle, but such a notion is involved in the corpuscular theories. On the other hand, it is easy to understand continuity being assured by a substance, capable of transversal vibrations, as we can see undulations of a string, and make resonance visible when a gas is the medium. Further than this, we can actually trace the period, amplitude, and shape of electric waves. The existence of the hypothetical ether is so well supported by innumerable facts that its actuality is indisputable to most of us. Now, supposing we admit the existence of all these moving corpuscles, what puts them in motion? Impact of a current of, or a wave motion in the ether, i.e., electric tension or light is thinkable. But let electricity be the corpuscles themselves and all reverts to chaos. Tyndall illustrates the convincing nature of the ether hypothesis in a striking manner in his discourse on "Scientific Use of Imagination" (Liverpool, 1870) in the following manner:—"If, therefore, you hold our President to be reasonable, it is because he behaves *as if* he were reasonable. As in the case of ether, beyond that '*as if*' you cannot go. Nay, I should not wonder if a close comparison of the data, on which both inferences rest, caused many respectable persons to conclude that the ether had the best of it." Later on he admits the less convincing nature of the existence of definite atoms, and adds:—"The chemists who recoil from these notions of atoms and molecules accept, without hesitation, the Undulatory Theory of Light."

Since then the atomic theory has received so great a support by observed facts that it is difficult to doubt the existence of material molecules in crystals at least. Still, the doubt regarding corpuscles entertained by the gigantic minds of that classical period of scientific thought goes to prove that corpuscular theories are repellent to human reason. As working hypotheses they serve their purpose, but to give every new notion the dignity of a theory in the philosophical sense seems to me to be somewhat presumptuous. I know very well that he who doubts is supposed to do so from lack of knowledge, but I think knowledge consisting in an unthinking acceptance of authority is hardly worth having. What proof is there that the deflection by a magnet of any kind of radiation involves its being of a corpuscular nature? The electric arc was known to be equally obliging, whilst we assumed it to be a motion of the ether setting ordinary molecules going. Light passes through the atmosphere along a curve on account of the continuous variation of density. You can produce a wave motion of a slack rope, &c. Hence wave motions

can bend under stress. On the other hand, are electrically charged bodies affected by the magnet? Seemingly only on the supposition that they move with a speed approximating that of the electric current. Could we not suppose that the deflection of the current of negative electrons in the vacuum tube is a parallel case with the electric arc, which in the case of alternating current certainly is undulatory, and that the molecular bombardment depends upon the great mean free path of the gas molecules, as Crookes, the discoverer of the phenomenon, would have it? What was there in ultra-gaseous matter less acceptable than the assumption of electrons, which seems to be another name for the same thing? It is not for me to attempt the unification of theories, but one would dearly like to see the logical necessity for the assumption of the existence of electrons, quanta, and the correlated high speeds, enormous atomic energy, &c. &c., brought to proof. That they suit certain of the newly discovered phenomena is no doubt correct, but that they will replace the established optical and electrical theories is highly doubtful. Till then they will remain emergency hypotheses, as a theory should be all-embracing.

In practical engineering, mechanical, electrical, and chemical, the world has benefited very little from the new theories and discoveries. If transmutation of metals should come, it would be worth very little. Atomic energy cannot be released without expenditure of a greater amount—should it exist. It would be of the same nature as that of liquid air, which will not work without the supply of the necessary heat. With regard to the various applications of electric waves, the discoveries belong to an earlier period, and the theory is in conformity with the undulatory one. In the case of heat we can absolutely leave what happens round about — 273 deg. Cent. on one side, and whether a metal melts at 1200 deg. Cent. or 2000 deg. Cent. is of minor importance. In this last field the modern development of metallurgy has rendered good service in the domain of heat treatment, but the development of electric smelting rests on the basis of the old story. Chemistry as an art and the chemical industry have proceeded on the old lines; even fixation of nitrogen by electricity goes back to Cavendish.

Probably the greatest gain to the older practical technologist derived from the acquaintance with the new things has been the preservation of a certain elasticity of mind. One sees the continuity of science, how the students of the 'seventies and 'eighties carry the knowledge of earlier times into the present, how the experimental methods of to-day are refinements of those of yore, &c. The somewhat absurd assumption that everything worth having is of modern origin is a belief created by certain daily papers, like the "too old at forty" doctrine.

A contributory factor is the introduction of mass production in education, technical or otherwise, which enforces the neglect of the study of the achievements of other times. I wonder how many men in this country know that a microphone telephone set, constructed on the same principle as the modern ones, apart from the iron diaphragm of the receiver being replaced by a sounding box of wood, was designed by one Dr. Reis, of Frankfort-on-the-Main, in 1860. It was tried successfully for transmitting a song a distance of 340ft. in 1861. A book before me, printed in 1873—thus four years before Bell's invention—gives very good illustration of the instrument, which was provided with a vibrating platinum contact micrometer. In view of the present broadcasting craze, I feel constrained to give the final remark on the instrument in the book:—"If the problem can be looked upon as solved in theory only, and the apparatus still lacks the perfection which would enable a speaker to charm great assemblies in as many and as distant places on earth as you like, it is still of sufficient interest to be mentioned here." People wanted something for their money in those days, and they were certainly somewhat unkind as critics. But self-criticism was also the rule, as anybody can see when perusing works by Darwin, Spencer, Tyndall, and others in this country, whose work mainly consisted in raising difficulties against their own theories. This seems to have gone out of fashion altogether now, as well as critical publications and commentaries. I do not envy the man who takes on the critical treatment of the scientific theories of the last thirty years, even should he get the same period of assured comfort to do it in.

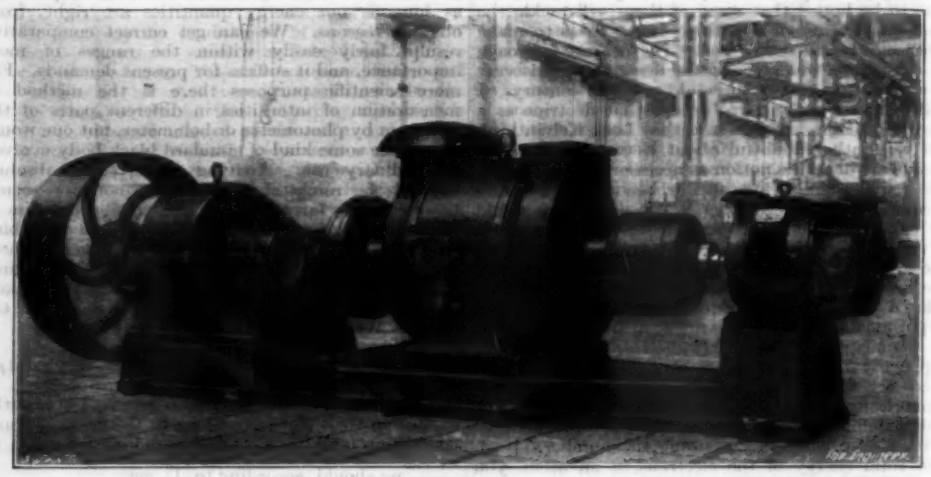


FIG. 36—AUTO-SYNCHRONOUS MOTOR FOR DRIVING A SCREENING PLANT

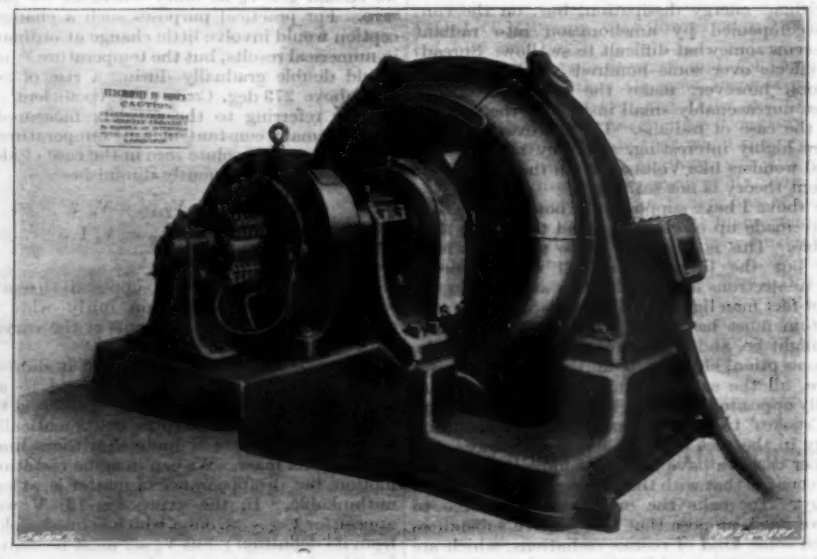
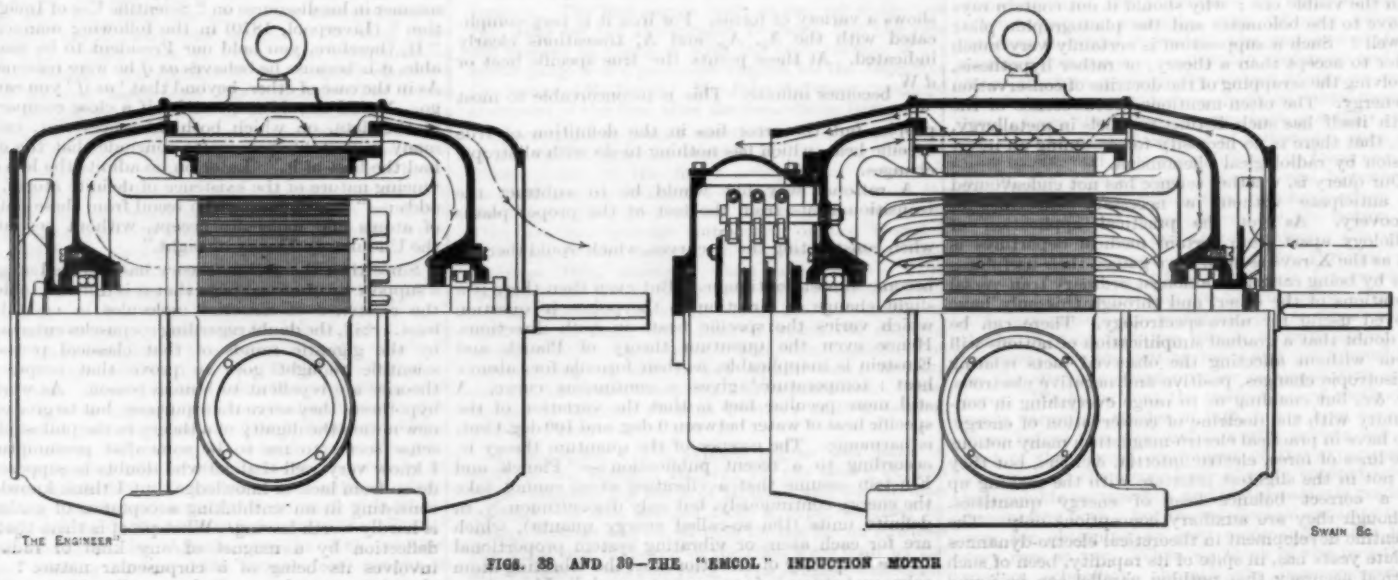


FIG. 37—SYNCHRONOUS MOTOR



THE ENGINEER SWAIN Sc.

FIGS. 38 AND 39—THE "EMCOL" INDUCTION MOTOR

Electricity in Mines.

No. VI.*

REVERTING to auto-synchronous motors, Fig. 36 shows a Crompton machine which is now in use at a South Wales colliery for driving a screening plant. It is well known that this class of plant is difficult to start, especially if it is shut down with the belts loaded. The motor shown, however, has been designed to start and synchronise against two and a-half times full load torque. The supply is a 500-volt, three-

* No. V. appeared August 24th, 1923.

phase, 50-cycle one, and when fed at this voltage and periodicity the motor runs at 1000 revolutions per minute and drives through helical tooth gearing on to a second shaft running at 250 revolutions per minute. The reduction ratio is 4 to 1, and on the second shaft there is a pulley 44in. in diameter, which drives the main shaft of the screening plant by means of a belt. The motor is designed to work at a power factor of .9 leading, and at full load the efficiency is 90 per cent. Both the motor and exciter are of the pipe ventilated type, and although the motor is situated in a very dusty position it draws clean air through a duct from an air filter situated outside the screening plant. The exciter, which is directly coupled to the synchronous motor, has a capacity of 128 ampères at a pressure of 28 volts, and it is connected directly to the liquid starter and to the slip rings of the rotor in accordance with the Crompton patents. As no switches are needed in the exciter circuit, the starting operation is extremely simple. The three-phase oil switch in the stator circuit is first closed and the liquid starter is then screwed down. In circuit with the field of the exciter there is a shunt regulator, which can be set in a given position to obtain the required leading power factor and does not require to be altered, save at the rare intervals when the load conditions vary and a new setting is desirable to obtain the required power factor correction. The machine under consideration has been in use for a considerable time and has proved quite capable of performing the duty for which it was designed. A reduction in the power costs has resulted from the high power factor which is maintained at the bus-bars.

The motor shown in Fig. 37 is a standard Crompton slow-speed synchronous machine designed for driving a main ventilating fan at a colliery, a considerable number of similar machines being in service. The particular motor illustrated gives a continuous output of 250 brake horse-power at 3000 volts and 50 cycles, the speed being 250 revolutions per minute.

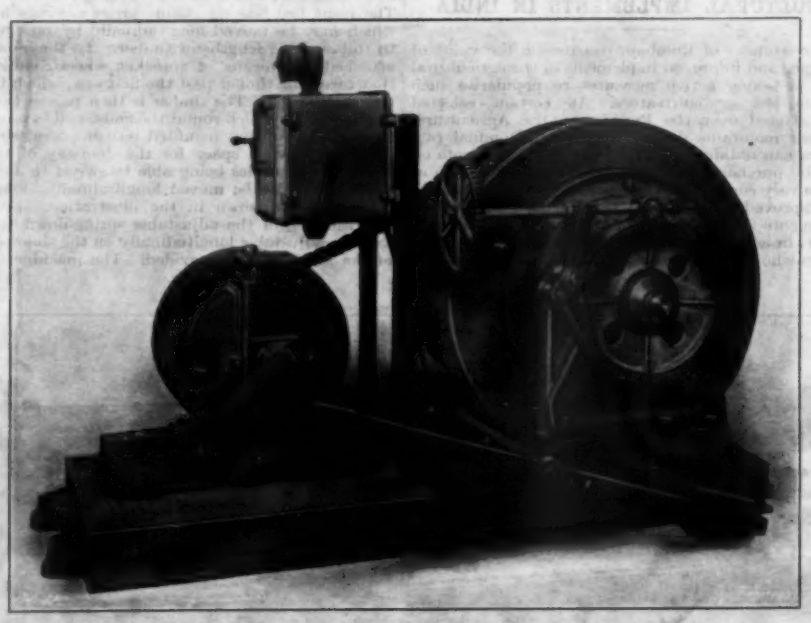


FIG. 40—ELECTRICAL HAULAGE GEAR

The machine works at .9 leading power factor. The makers of these machines find that so far as collieries are concerned no standard has been adopted with regard to the amount of lag or lead desired. Each case is usually considered on its merits and the leading power factor varies from .9 to .7 lead for fan drives. The maximum efficiency of a synchronous motor is at unity power factor. The efficiency at .9 leading is slightly less than that obtained at unity power factor, but if a power factor of .7 leading is required a considerably larger machine is necessary and the efficiency is somewhat lower. The motor illustrated in Fig. 37, naturally, runs at constant speed, but the design allows of a larger rope pulley being fitted later on when an increased air pressure is required from the fan. If the shunt regulator of the exciter of an auto-synchronous motor is set to give the necessary leading component at full load, then if the load is reduced the rotor current naturally remains the same, and consequently the motor has a leading current component greater than at the initial load.

A type of induction motor which may interest mining engineers is the Emcol machine made by Walter McGee and Sons, Limited, of Albion Works, Paisley. Whilst this motor is totally enclosed, it is also effectively ventilated. The drawing Fig. 38 shows how the windings and bearings are completely sealed. When the motor is running the air in the interior of the machine is circulated by means of a fan fixed to the rotor, and the air passes through a series of tubes which pass axially through the inside of the frame. An external air current is also automatically drawn through the outside casing of the motor by a fan fixed to the rotor shaft. Striking on the outside surface of the internal air tubes and core the external air provides the cooling effect without actually coming into contact with the inside of the motor. The method of applying the system to a slip-ring motor is shown in Fig. 39, and shows the slip rings themselves all enclosed, so that the motor can be used with safety in fiery mines.

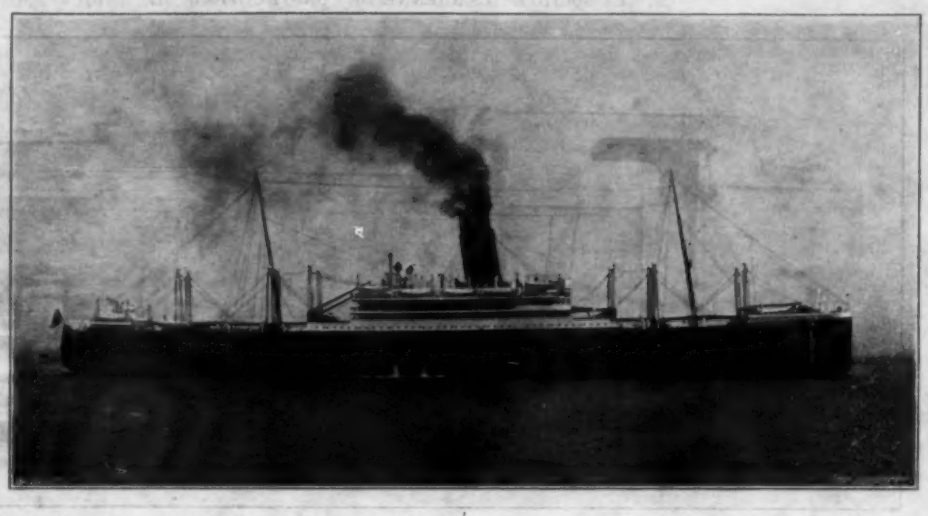
The haulage gear shown in Fig. 40, has internal self-lubricating gearing, and has been designed by David Ashton and Co., Limited, of Aztec Works, Neepsend, Sheffield. The gearing is totally enclosed inside the drum or surge wheel, which provides a dirt, dust and waterproof casing and also forms a chamber for the lubricating oil which is splashed freely on the revolving gears. Apart from the fact that a very perfect lubricating system is provided, the gear is protected so as to avoid accidents. No dog or claw clutch is used. Perfect control is obtained by means of the slow-speed friction clutch. The gears can be examined and withdrawn without disturbing the drum or rope simply by removing one pedestal and end plate, when the gears can be removed intact. The drum can be run free by means of the hand wheel operating the friction clutch, and a heavy load can be slowly picked up with the engine or motor running at full speed. A band brake acting directly on the drum is operated by a foot lever, the brake and clutch bands being fitted with asbestos metal linings. It is said to be impossible to damage the engine, motor or gearing by careless manipulation. The gear wheels, which are machine cut, are of ample proportions and run silently. The shafts and spindles work in long gun-metal bearings which are automatically lubricated. The large diameter drum is proportioned to withstand heavy strains and constant wear. The end plates, brake rim and flanges are integral castings, but mild steel flanges and a detachable brake rim can be fitted if desired. The whole equipment is mounted on a substantial box bed-plate or girder frame, or is placed on a four-wheel trolley. If steam or compressed air is used for driving, the engine is of the oscillating double, diagonal type.

As will be seen from Fig. 40, the application of electric driving to these haulage drums results in a very neat and compact arrangement, which is said to run silently and to be very efficient. The large-diameter slow-speed friction clutch controlling planet arms inside the drum enables the load to be taken up slowly when the motor is running at full speed. Squirrel-cage motors can therefore be used without difficulty. For the purpose of conversion from electricity to compressed air or *vice versâ* the makers have designed a very compact totally enclosed self-lubricating three-cylinder high-speed engine which occupies about the same space as a corresponding electric motor.

In conjunction with the internally geared drum a multiple belt drive is used as shown, an arrangement which is considered to be preferable to toothed gearing driving direct from a high-speed motor or air engine. The belting is made up of reinforced leather links and runs in V-shaped grooved pulleys. The drive is claimed to combine all the best features of the ordinary flat belt, rope and chain drives. It is flexible and silent and is not affected by atmospheric conditions. It can run quite slack at very short centres without slipping, it requires no fastener, and the length of the belt can be adjusted in a few minutes by removing or adding a link. The standard belt used is 1¼in. wide, and each belt will easily transmit 10 horse-power at a speed of 2000ft. per minute, and at 2ft. 6in. centres up to 6ft. centres it will transmit 30 horse-power.

THE ATLANTIC TRANSPORT LINER MINNEWASKA

HARLAND AND WOLFF, LIMITED, BELFAST, BUILDERS



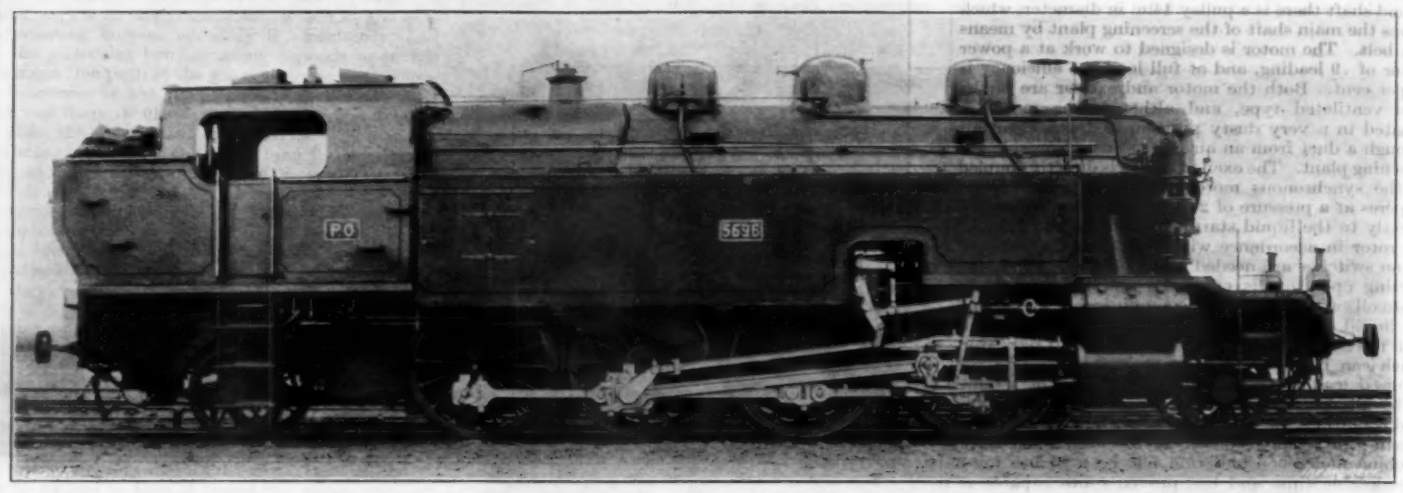
The Atlantic Transport Liner Minnewaska.

AFTER undergoing successful builders' trials, the new liner Minnewaska left Harland and Wolff's yard during last week-end and arrived in London on Monday evening, where she anchored in King George V. Dock. With this ship, which is the largest and finest Atlantic liner sailing from London, the Atlantic Transport Line re-opens on Saturday, September 1st, its direct passenger service from London to New York, which has been suspended since the war owing to the loss of all its "Minne" class of ships by enemy action. The new Minnewaska is noteworthy only on account of her size and the excellence of her cabin and public room appointments. She carries first-class passengers only, and state-rooms are provided for 369 persons. With a length of 625ft. and a breadth of 80ft., it has been possible to provide a cargo-carrying capacity of 17,000 tons deadweight, which, we understand, is larger than that of any other ship afloat. The wide beam of the vessel also gives large and free deck spaces, and confers great stability and steadiness. In an article which appeared in THE ENGINEER of June 15th, the machinery of the Minnewaska was described and illustrated. It comprises two sets of Brown-Curtis single-reduction geared turbines with the high-pressure turbine exhausting into the low-pressure turbine and thence to the condenser. Astern wheels are fitted in the low-pressure turbine casing. Each set develops 9000 shaft horse-power, giving a total of 18,000 horse-power corresponding to a ship speed of about 18 knots. Steam is generated in twelve water-tube boilers, arranged for oil burning. The working pressure is 215 lb. per square inch, and superheat of 100 deg. Fah. is used. In accordance with Harland and Wolff's latest practice, all the engine-room auxiliary machinery is electrically driven, and electric motors are used for ventilating fans, kitchen machinery and lifts, and for operating the water-tight doors. The cargo is worked by thirty-six electric winches.

An interesting feature of the arrival of the Minnewaska in the Thames on Monday last, was the ease with which she was navigated through the comparatively narrow channel for large steamer traffic. In order to avoid swinging with the tide, if she were coming up channel on the flood and found it necessary to anchor in an emergency, a stern anchor is employed, and under a new regulation which has been approved by the Port of London Authority, a special signal flag is hoisted when this anchor is dropped. There is no doubt that the new direct passenger and cargo service of the Atlantic Transport Line will prove popular, and a happy feature of the arrangements made is that a fast service of motor cars will convey passengers to and from the ship.

PARIS-ORLEANS RAILWAY—EIGHT-COUPLED TANK ENGINE

LA SOCIETE ALSACIENNE DE CONSTRUCTIONS MECANIQUES, MULHOUSE, ENGINEERS



Tank Engines of the Paris-Orleans Railway.

We reproduce herewith a photograph of one of the eight-coupled tank engines which are now being used on the Paris-Orleans Railway. The class is numbered 5616 to 5740, and the particular engine illustrated, No. 5696, was built by the Société Alsacienne in 1921. Some of the class, Nos. 5616 to 5650, are fitted with special apparatus for condensation of the exhaust, and, in consequence, weigh more than the others when empty but less when in running order. The actual weights are, in round numbers :—For the non-condensing engines, 78 tons empty and 97 tons full, and for the condensing engines 80 tons empty and 96 tons full. The axle load on the four-coupled axles is practically 17½ tons in running order for both types.

The principal dimensions and weights are tabulated below. Nos. 5616 to 5640 have steel fire-boxes.

Paris-Orleans Railway, 2-8-2 Passenger Tank Engine.

Specification.

Cylinders (two)	23.62in. by 27.56in.
Wheels, diameter—	
Leading and trailing	41.34in.
Driving	71in.
Boiler, steel—	
Working pressure	170 lb. per sq. in.
Diameter	59.4in.
Length between tube plates	13ft. 11.5in.
Thickness of boiler plates	.59in.
Thickness of smoke-box tube sheet	.99in.
Fire-box, steel, Belpaire—	
Length, top	94.2in.
bottom	107.6in.
Width, top	48.9in.
bottom	39.8in.
Thickness of sides	.394in.
Thickness of tube plate	.512in.
Diameter of stays	.9in.
Grate—	
Length	108.8in.
Width	39.8in.
Area	29.8 sq. ft.
Brick arch—	
Length	43.3in.
Width	39.4in.
Thickness	4.3in.
Boiler tubes, steel—	
Number, small	134
large	21
Length between the tube plates	14ft. 5⅛in.
External diameter, small	2in.
large	5.25in.
Thickness, small	.098in.
large	.157in.
Heating surface—	
Fire-box	155.5 sq. ft.
Tubes	1304.7 sq. ft.
Total	1460.26 sq. ft.
Superheating surface—	
Exterior of tubes	441.3 sq. ft.
Weight—	
Empty	77 tons 19 cwt.
In working order	97 tons 8 cwt.
Coal, capacity of bunker	4 tons
Water in tanks	1320 gallons

Special fittings : Air brake (Westinghouse), speed indicator, piston valves, superheater, steam heating for train.

AGRICULTURAL IMPLEMENTS IN INDIA.

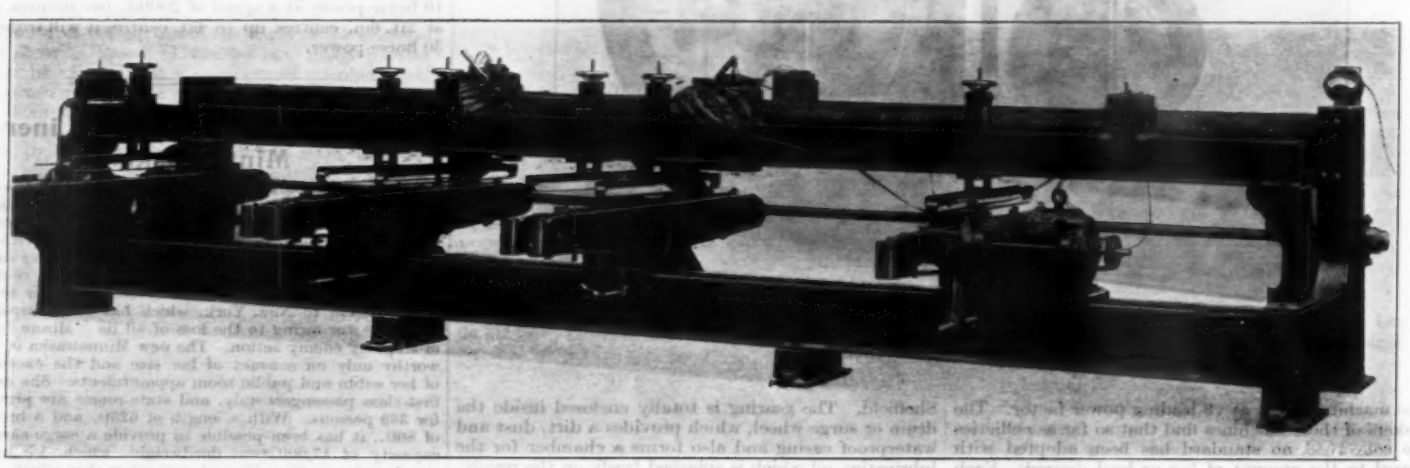
The Government of Bombay, recognising the value of well-designed and improved implements in the agricultural industry, is taking active measures to popularise such implements among cultivators. At certain selected places, scattered over the Presidency, the Agricultural Department maintains depôts where at a nominal rate cultivators can obtain new and improved implements on hire and by purchase. The Indian agriculturists, who as a class are very conservative, are slowly but surely taking to these improved implements. In some parts the demand for implements for hire is steadily growing, so that the hiring out, in addition to providing facilities for the poor cultivators who are unable to meet the initial cost of actual purchase, is also a remunerative business undertaking for any enterprising firm desirous of popularising its goods. Some of the newly-started agricultural associations keep a stock for hire and are thus helping to introduce up-to-date imported implements.

The largest demand for such improved implements is from the canal tracts where irrigation canals are bringing into cultivation large areas of virgin soil. Enquiry into the conditions prevailing in different parts of India show that there is need for designing new kinds of implements suitable for the varying geological conditions. There are perhaps few countries in the world where the climate and soil varies so much as in India. It is, therefore, impossible to determine a standard in agricultural implements suitable for all conditions.

Apart from a steady demand for improved ploughs, puddlers and threshing machines, a call for other varieties of machinery is also growing. For instance, in cane-growing districts the demand for the improved type of pans for boiling sugar cane juice has been rapidly increasing. The pig-proof woven wire fence, which has proved to be of great utility in jungle districts, is in great demand among the richer class of landowners. As the Agricultural Department acts in the districts as adviser to the purchaser of implements, it is suggested as being best that manufacturers should first demonstrate the merits of their machines to the officers of the Government Agricultural Department.

Machine for Cross-cutting and Rounding Timber.

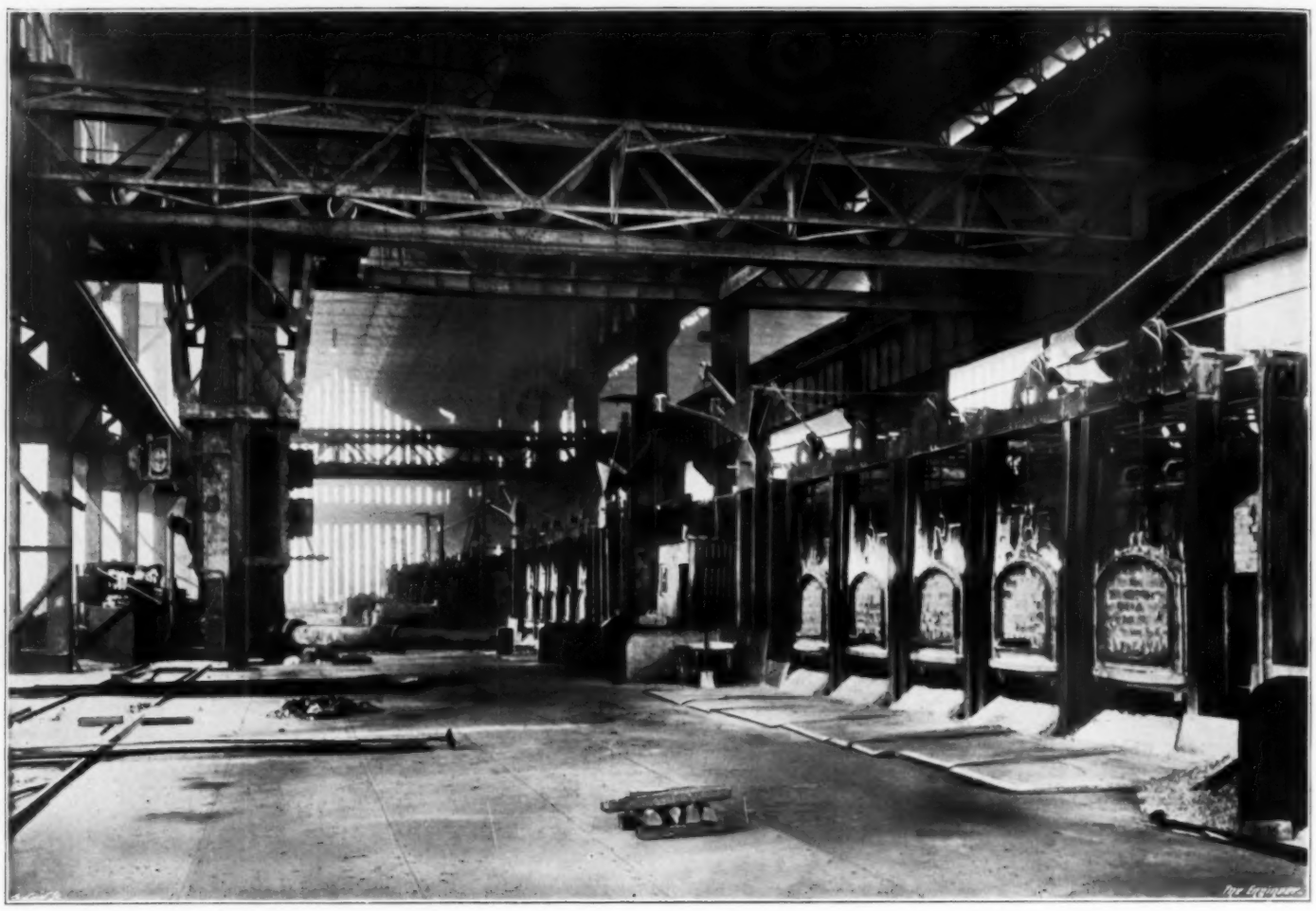
A machine for rounding and cross-cutting deals for railway wagon sides has recently been constructed for the London and North-Eastern Railway Company's new wagon works at Darlington by John Pickles and Son (Engineers), Limited, of Hebden Bridge. The machine, which is illustrated below, consists of a strong built-up main frame, to which all the working parts are attached. The front bed has six chain carrier castings fixed to it, which may be moved longitudinally by rack and pinion to suit varying lengths of timber. To these castings are attached, by means of sprocket wheels, endless chains that carry the timber past the first saw, which trims it off to exact length. The timber is then passed through two sets of cutters which round the ends, and is propelled still further to two saws mounted on compound slides which cut it to leave a space for the doorway of the wagon. These saws, besides being able to swivel to any required angle, may also be moved longitudinally along a heavy back slide as shown in the illustration. Six separate "pressures" of the adjustable spring-down type, which are also adjustable longitudinally on the slideway in front of the machine, are provided. The machine is self-contained, electric motors being fixed to each of the four saddles. The moulding cutters and swivelling saws are direct coupled to their motors, whilst the trimming-off saw is driven by a "V" belt from grooved pulleys on the motor shaft. The machine is 25ft. long and it can deal with timber up to 20ft. by 9ft. 3in.



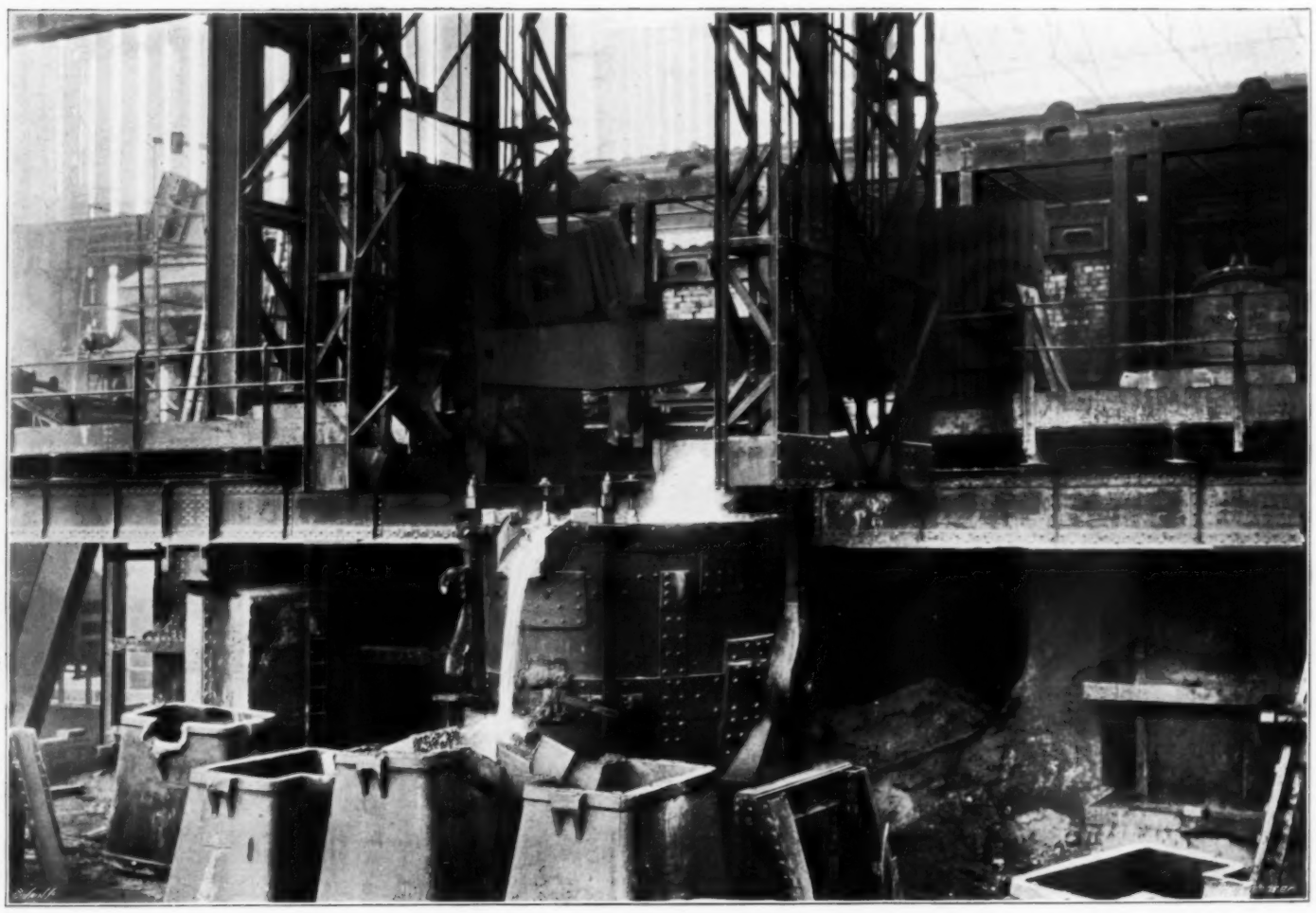
MACHINE FOR ROUNDING AND CROSS-CUTTING DEALS FOR RAILWAY WAGON SIDES

In many of the cities in the United States there are stations owned jointly by several companies. The latter form themselves into an independent company, which is known as a "terminal company," having its own staff of inspectors, porters, signalmen, &c. A correspondent recently furnished the *Railway Age*—New York—with some "Observations of a Transcontinental Traveller," in which complaint was made of the indifference found among the staff at these terminal stations as compared with the interest exhibited at stations owned and worked by one company. As an illustration, the correspondent said he had taken his luggage to the baggage room at a terminal station twenty minutes before the departure of the train and asked whether it would be sent by the train he himself was travelling by, and the reply he received was, "Maybe it will and maybe it won't. I don't know." Similar ownership, but to a lesser degree, prevails in this country. Carlisle is a case in point, but we cannot imagine such indifference prevailing there or elsewhere in Great Britain.

THE CLYDEBRIDGE STEELWORKS AT CAMBUSLANG



STEEL MELTING FURNACES SEEN FROM CHARGING PLATFORM



TAPPING PLATFORM SHOWING 70-TON LADLE AND CRANE

INGOT RE-HEATING FURNACES WITH COVER LIFTING CRANE

SLAB COGGING MILL WITH HYDRAULIC SIDE ADJUSTERS

American Engineering News.

(From our own Correspondent.)

SIX-MILE RAILWAY TUNNEL.

All preliminary steps have now been completed for the construction of the Moffat Tunnel to carry the Denver and Salt Lake Railway through the Rocky Mountains at a low elevation, thus eliminating the present line across an open pass above snow line and reached by gradients of 1 in 25. The tunnel will not be built by the railway, which could not raise the necessary funds, but by a local improvement society which will issue bonds. The plans have been approved by a board of engineers experienced in tunnel work, and the new chief engineer has had experience on the long rock tunnels of the Catskill aqueduct for New York City water supply. The tunnel will be 31,875ft. long, with a gradient of 1 in 125 rising from the west portal to a summit elevation 9240ft. above sea level and descending at 1 in 330 to the east portal. Its section will be 16ft. by 24ft. A pioneer or pilot tunnel will be driven 75ft. from the centre line of the main tunnel, so that the latter can be attacked from several headings, the pilot tunnel serving for ventilation and the hauling of supplies and excavated material. The rock is mainly granite, with some gneiss and schist. It is estimated that the work can be completed in three years at a cost of 33,600,000 dollars. Besides shortening the distance and eliminating the present open summit at 11,660ft. above sea level, the maximum gradients will be 1 in 55 and the sharpest curves 575ft. radius.

DOUBLE-DECK CONCRETE ARCH BRIDGE.

An unusual type of structure built recently across the Black River at Watertown, U.S.A., is an arch rib bridge carrying an upper roadway by means of spandril columns and a lower roadway by hangers. The structure is of reinforced concrete with a span of 200ft., the arch having a rise of 38ft. The four arch ribs are 6ft. wide and 5ft. deep, with spandril columns seated on the inner part of the rib and connected by cross girders, between which are the joists carrying the two 12ft. roadways and 6ft. sidewalks. The hangers are in similar positions and carry roadways and footpaths 22ft. below the upper deck and 16ft. above the springing line, the footpaths being supported on the cantilever ends of the floor beams. When concrete was poured for the ribs, conical openings with the wider mouth upward were left at the points of attachment for the hangers, and through these the vertical reinforcing rods were placed, being hooked to the longitudinal rods in the ribs. When the lower deck was completed the removal of the falsework left the hanger rods subjected to the full dead load of this deck. Moulds were then placed and the concrete for the hangers was poured, while at the same time the conical openings in the ribs were filled with concrete. This was done so that cracking of the hanger concrete might be avoided, since any additional elongation due to live load would be insignificant.

STANDARDISING AMERICAN CONSTRUCTION MACHINERY.

Instituted by the American Association of General Contractors, a joint committee composed of contractors, engineers and manufacturers of construction machinery is working for a reduction in the various sizes and styles of machines. One of its first steps has been to reduce the number of sizes of concrete mixers, and to standardise certain requirements. This in no way affects individual design or improvement, but will result in economy and convenience to both the makers and users of the machines. For building and similar work four sizes are recommended; and for paving work, three sizes. This is for ordinary use. For very large works large machines may be and are being built. Speed of drum is to be rated by peripheral speed at centre of charge, rather than by revolutions per minute. Tanks for 150 lb. pressure are to be of specified capacity for the different machines. Charging skips are to be made with closed ends. Shafts, gears, keyways, &c., and engine ratings are to conform to the standards of the American Society of Mechanical Engineers. Hand-operated discharge and discharge at one end only are standard, but power discharge and both-end discharge may be furnished as extras. Power steering is provided for paving machines on caterpillar tracks, and their speeds are to be between ½ mile and 1½ miles per hour. The recommendations of the committee now await approval.

TWELVE-HOUR DAY AT AMERICAN STEEL WORKS.

For several years the United States Steel Corporation has been the subject of attack for its adherence to the 12-hour shift in certain departments. The main reasons given for this practice are the short supply of labour, the difficulty of making a change, and the alleged fact that the men prefer the long shift for sake of the money. The deteriorating effect of such long shifts at strenuous work for six and seven days a week upon the moral, mental and physical qualities of the men appears to be left out of consideration. The company's claims as to the difficulties and manufacturing troubles due to a change to an eight-hour day have been refuted by the Colorado Steel and Iron Company, which is one of the large independent concerns outside of the Steel Corporation or "steel trust." This company made the change in 1918 at the repeated request of its workmen, and at the same time the hourly tonnage and piece rates were increased 10 per cent., so that the men would not lose money by the change. There has been no loss to the company either in output or cost of production. At first the labour cost increased about 1 per cent. at the blast and open-hearth furnaces, but decreased materially at the rolling mills. Further, there has been no shortage of labour, though the works employ over 6000 men, and the eight-hour shift is considered to be one reason for this, since the men are more satisfied.

MOTOR TRIALS IN RUSSIA.

It is announced that in connection with the motor trials which will be held in Russia next September, the course for passenger cars will cover about 1600 kiloms. and comprise Moscow-Viazma-Smolensk-Vitebsk-Pskov-Petrograd-Novgorod-Tver-Moscow, with an average daily run of 250–300 kiloms. The motor lorry course will comprise Moscow-Mojaisk-Viazma-Mojaisk-Moscow and cover about 750 kiloms., with an average daily run of 120–150 kiloms. The object of the trial runs is to determine the soundness and power of endurance, the fuel consumption and the range and speed of the various machines.

Both new and used cars of Russian as well as foreign make may participate in the competition. In the case of firms which have not heretofore taken part in Russian competitions, three machines must be sent for the present trial runs. A smaller number may, however, be admitted by the committee on the receipt of a special application from the entrant showing why it is impossible for him to enter three machines. Fuel and lubricants of a uniform quality will be placed by the committee at the disposal of entrants, their cost being covered by the fees paid for the right of participating in the competition. No other fuel or lubricants may be used during the trial. Tests for the strength and durability of motor tires will also take place, under specified conditions, during the competition.

Prizes, contributed by various institutions interested in the trial runs are to be awarded to crews, owners and firms whose machines have completed the course with a minimum of penalties. The scale of awards and diplomas has been worked out by a technical commission in such a manner as to provide separate prizes for every class of motor. Trials for motor cycles, similar to those for other motor vehicles, will also take place on the course Moscow-Mojaisk-Viazma - Smolensk - Roslavl - Yukhnov - Podolsk-Moscow, altogether about 1000 kiloms.

The cars will be delivered at the starting point—in Moscow—at the owner's cost and risk, but no duty will be charged for the importation or exportation of machines taking part in the trials.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Optimistic Ironmasters.

Staffordshire ironmasters for the most part, in spite of the continued depression in the industry, are rather more optimistic. Business has been very bad indeed, and they are anxiously on the look-out for the autumn demand. They are expecting a great improvement in business in September, though it must be admitted that up to the present definite signs of a trade revival are not discernible. Activity in the Black Country district is restricted almost entirely to isolated mills. To an increasing extent the mills are re-rolling steel in the absence of iron orders, and forges, in consequence, are doing relatively less work than the mills. Ironmasters must, in many cases, be losing money on the present meagre turnover, but they hope for better things as soon as August is passed. Makers of marked bars are, I am happy to state, meeting with a slightly increased demand and are well able to maintain the £14 10s. standard for their production. Makers of second-class iron are not in such a happy position. Demand is small and values are below the recognised standard figures. Crown bars have a level of about £12, though some makers in North Staffordshire claim that they are able to command a higher figure. Merchant bars are offered at from £11 10s. to £11 15s. Since Lancashire houses have signified their willingness to accept £10 17s. 6d. for nut and bolt bars, Staffordshire houses have been cutting this figure in an endeavour to hold the few orders which are being given out. They have also agreed, in many cases, to supply fencing iron at the same figure, though this material usually commands 2s. 6d. to 5s. extra. But a large proportion of the material used is Belgian, obtainable at from £8 17s. 6d. to £9 delivered in the district. The nut and bolt trade is very dull, and competition for business is keen. The continuance of the boilermakers' dispute becomes more serious every week, and is now having an increasing effect upon the nut and bolt trade as well as the chain and anchor industries in this district. Wrought iron gas tube strip this week commands about £12 10s. with £12 12s. 6d. as a maximum.

Cheaper Pig Iron.

The fall in pig iron values continues, not even the drastic curtailment of output being effectual in checking the downward movement. Iron is in very poor demand, and those who would sell are forced to meet buyers with regard to price. Derbyshire makers have not been successful in finding customers for No. 3 foundry iron at £4 15s. at furnaces. The position has not been definitely surrendered, but some business has been put through at a cheaper rate. Northamptonshire houses have for the most part made a definite reduction of 2s. 6d. per ton in foundry quality prices. They now quote £4 12s. 6d. Even this price, it is reported, has been shaded in particular instances. For Derbyshire forge £4 5s. is quoted, and for Northamptonshire £4 3s. Efforts are being made to arrest the deterioration of the market, and some of the furnace owners are holding out for higher prices, stating that business on the present basis is unremunerative. There is more pig iron in stock in this district than producers like, and competition for the meagre amount of business being done is keen. Some inquiries for export continue to reach Midland furnaces, but they cannot meet the competition of furnaces on the coast, and, as a rule, the inquiries do not materialise. The fuel question causes less apprehension than has been the case of late, for at a recent conference between Midland blast-furnace owners and coke producers it was agreed that the existing price of £1 6s. for furnace coke at the ovens should be continued, at any rate, for the present. It is thought that supplies will be somewhat more plentiful than they have been, in view of some reaction in continental buying.

Steel Values.

Business in the steel department is, for the most part, quiet and prices are finely cut. Despite the fact that values of finished material have for some time past been considered by producers to be unprofitable, they have, this week, shown further weakness. Sections, in some cases, have been sold at £9 10s. per ton, being a reduction of 5s. per ton on last week's price. Some increased firmness on the Continent has raised the Belgian quotation for this class of product to £9 16s. delivered, enabling the home producer to retain his hold on the market. Rollers of small bars now generally quote £9 10s. for their products. Substantially less than this figure is stated to have been accepted in some special cases. The position with regard to billets is somewhat baffling. Prices show a wide divergence. Sellers generally ask £7 15s. for native mild steel billets. Some of them allow business to pass rather than accept less. Others, however, are prepared to accept £7 12s. 6d., and even £7 10s. is mentioned by some buyers as a possible figure. On the other hand, there are firms which have declined to go below £8. It is still possible to buy Belgian billets at £7 10s., but in view of the cash terms and slower deliveries, this is not a competitive figure, and what orders are given out are secured by native steel works. Competition is keener in re-rolling, and many of the Black Country ironworks are transferring to steel in the absence of iron business. Orders for small angles and steel gas strip are keenly competed for, this material now generally being preferred to iron in view of the wide difference between the prices of the two materials.

Sheet Mills Well Booked.

Galvanised sheets show further improvement, a lot of work having lately been booked for India. The recent figures of £18 10s. for home and £18 15s. to £19 for export are easily maintained. The firmness of prices is further assisted by the rise in spelter values. Several large sheet mills have work on hand to occupy them until the end of the year. The black sheet trade also shows improvement, good productions now being made.

Steel Scrap.

The steel scrap business is almost stagnant, but the holders of material are confident that better prices will reward a waiting policy. In spite of the general dulness, there is a growing expectation of renewed buying in September.

Constructional Engineers and Rail Rates.

Constructional engineers in the Midlands express much disappointment with the recent reductions in the railway rates. Their competitors on the coast escape the rail rates and thereby have, for some time past, captured the larger share of the business. The present concessions are insufficient, materially, to alter the position. It is held that the outside reduction is 1s. 1d. per ton of steel, and that users of the Port of London benefit to the extent of 1s. on Birmingham consignments. From 5d. to 7d. per ton is the advantage on certain parcels from Midland works within the Birmingham area. But on parcels coming from Scotland and the North of England, the rate remains unchanged. The expansion in the building trade has brought rather more work to constructors, who are calling for more steel.

Rolling Stock Business.

Midland railway rolling stock works continue well employed, but their orders are nearly all on foreign account. The home railways continue to hold up contracts for rails and railway equipment. It is thought that the railway amalgamation is partly accountable for this postponement of orders, the companies taking advantage of each others' stock and plant to an extent which was formerly impossible.

Coventry's Industries.

Business in the motor engineering industry in Coventry is considered satisfactory, orders keeping up beyond manufacturers' expectations. There is, naturally, a falling off of business, for at this late period of the year agents do not buy for stock. The extended home demand is very welcome as export business is still slow. Australia and New Zealand have provided improved business of late, but the demands of other markets are few. The motor lorry subsidy is welcomed by Coventry manufacturers as a step in the right direction, but it is not anticipated the benefits to the trade will be felt to any great extent for some time.

Midland Canal Traffic.

Owing to the continuance of the strike of canal boatmen, who some weeks ago ceased work rather than accept a reduction in wages, merchandise from the metal-working districts of the Midlands for shipment in the Thames and the Mersey that for many years has been waterborne, is passing to the railways and other carriers, perhaps with, in many cases, little chance of return to the canals when the dispute is over. The position in Birmingham is unchanged, but further efforts are being made to effect a settlement.

Cannock Chase Miners' Wages.

The new ascertainment for miners' wages in September and October in the Cannock Chase coalfield shows practically no change from the July and August rates. The stallman's minimum wage remains at 10s. 5s. a shift, and in the other classes of mine workers the difference will not be more than a halfpenny. There

is less activity in the Staffordshire coalfields. At some of the pits in this district miners are not working much more than half-time. The industrial fuel requirements are considerably reduced as compared with three months ago.

Edge Tools.

Midland edge tool firms report that business has been easing up all round during the past few weeks, and this is most noticeable in the heavy branch where shorter hours are being worked. Only small quantities are called for by the various oversea markets, and though this is the slack season demand is stated to be abnormally low.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE markets in Lancashire for iron and metals remain quiet, but one is inclined to doubt whether the feeling is now quite so depressed as it was. It cannot be said that there is any increase in the volume of business; on the contrary, many people say that there is at the moment less business than there was; and there is no sign of any improvement in the prices. Apparently what constitutes the better feeling, that is if it be assumed to exist, is probably a growing belief that prices are near the bottom. One or two merchants, usually of the "bear" type of mind, have expressed this view recently. A good deal of productive work has been stopped lately because the prices available were so entirely unprofitable. But although this is the case, it is still easy to buy at the bottom prices; so that this stoppage of furnaces and steel works has not yet interfered with the adequacy of the supply. Rumours of the further damping down of furnaces are current.

Metals.

The market for copper has been fairly steady here, the demand remaining very quiet. There is not much room for any further depreciation, and apparently the time has not yet come for any serious upward movement. Refined ingot copper is admittedly cheap, but consumers seem to think that there will be plenty of time in which to make cheap purchases, and hence are in no hurry to do anything. The American market has been firm, and there has been some advance in American prices, but not enough to have any definite effect here. There was some hope expressed last week in relation to the European position, it being thought that we were nearer a settlement; and this seems to have caused a better feeling for a time in the copper market; but one does not now see that any practicable measures are being taken to improve the continental situation, and this improvement is probably necessary before any continuous revival in copper consumption can take place. The position in the scrap metal market seems to be much as it was. Dealers are buying at low prices, say about £61 for clean scrap copper, £46 for gun-metal, and £38 for heavy yellow brass; and by this time they must have a fair accumulation of cheap scrap in their warehouses. Those consumers who care to use this scrap material ought to be able to supply themselves at low prices. For manufactured material the prices quoted are £98 per ton for strong sheets; £108 for flat bottoms; 1s. 1½d. per pound for copper locomotive tubes, and 1s. per pound for brass; brass condenser tubes 1s. 2¼d. per pound. In the tin market there was some American buying of metal which stimulated prices; but in any case there seems to be a much better feeling in tin than in copper. There is a belief that the statistics at the end of the month will show a more favourable position. Should these anticipations be disappointed, there may be a little reaction, unless American buying sets in again. The home demand for the metal is not particularly good at present. Lead has been a steady market, with a slight upward tendency. Spelter remains firm, and some buying of American spelter has taken place. The advance in spelter since the beginning of July now amounts to over £5 per ton, and possibly the upward movement has gone far enough.

Pig Iron.

The market here for foundry pig iron does not show any definite change, and the price of No. 3 is still based on 92s. 6d. per ton at the Derbyshire furnaces, but although one hesitates to speak with any certainty, there is probably a rather better feeling. Consumers here are still fixed in their belief that the prices will have to come down still further, and they continue the practice of buying only small lots for prompt use; but some of the merchants take a rather different view of the market, and are not so ready to make "bear" sales. One does not see quite clearly on what the change—if there be any—is based, for trade remains dull and restricted; and it is clear that the ironfounders of this district are not yet well supplied with orders; but it is something to have a little more cheerfulness in the market even although it may not mean much. The end of the holiday season may perhaps be sufficient to account for a rather better feeling. Forge pig iron is rather depressed and about 85s. per ton is quoted for it at the Derbyshire furnaces. The loss on this quality must be rather serious, but of course only a small quantity is made. The demand here for Scotch foundry iron remains poor, and the prices are, according to report, rather irregular. One hears of 112s. 6d. delivered; but probably from 115s. to 117s. 6d. delivered is nearer the usual price. East Coast hematite is firmer, and some sellers now quote 112s. 6d. per ton delivered in Manchester.

Steel.

The market for manufactured steel does not show any change. There is very little business activity here, but what there is takes place at about last week's prices, say, £9 10s. for joists and angles, and £9 15s. to £10 for plates. There was some hope that the meeting of the Engineering Federation with the boilermakers would lead to a settlement and bring about a better demand for steel plates, but such hope is now apparently to be discarded again.

Scrap.

The market for all the scrap materials keeps very quiet, and so far one cannot see that the better feeling in pig iron has had any effect. Of course, if any movement in pig iron should lead to a revival in the demand for castings, cast scrap would respond immediately; and as the best qualities of cast scrap can now be bought at 15s. below the price of common pig iron one would say that ironfounders should hold a fair stock of this cheap foundry material. For heavy wrought scrap iron the Lancashire works are still paying from 75s. to 77s. 6d. per ton delivered. One hears very little about steel melting scrap here, but from 60s. to 62s. 6d. per ton on trucks at a Lancashire station is about the value.

The Textile Machinery Trade.

An optimistic note was struck by Mr. Whitby, the chairman of John Hetherington and Sons, textile machinery makers, at a meeting of the shareholders in this successful company, held on Monday last. Referring to the present pessimism with regard to the cotton trade, Mr. Whitby remarked that he had been hearing all his life that this country's cotton trade was "done for," but it kept repeating its bright periods and became more profitable. He said that he saw no reason for the prevailing despondency, and believed that more textile machinery than ever would be called for. Textile machinery makers would have been in a very sorry position if they had had to rely upon Lancashire orders since they resumed their ordinary work after the war, as very few mills had been built or equipped during that period. Other countries had come to the rescue, India, China, Japan and France all having been particularly good customers. Mr. Whitby went on to say that a considerable number of orders for machinery were suspended for the present on account of the upset and unrest in the foreign political world, principally in the East. In China the great difficulty was in getting merchandise from the ports to the interior owing to the internal disorder. Referring to the home trade in textile machinery, Mr. Whitby said that by the time the foreign demand slackens off Lancashire will perhaps be able to take a step forward, for he said there must be a considerable amount of machinery which is worn out or obsolete, and which the owners would have replaced long ago if prices had not been considered too high. It was reasonable also to expect that there will be a resumption of mill building when spinning and weaving become profitable again. Although the existing mills and plant were sufficient when the war began it must be taken into consideration that the working week of cotton operatives had in the meantime been reduced from 55½ hours to 48 hours per week, so that more mills will be required if the pre-war output is again to be reached. Mr. Whitby's company has recently published its report on the past year's trading, which was the best in the history of the firm.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is a slight hope if the boilermakers adjust their differences that there will be an improvement in the hematite iron trade. Undoubtedly this dispute has affected the trade, and business with Scotland has fallen off considerably. There are other important factors as well as this long drawn dispute, but certainly it is having its effect on business. The trade with South Wales is not big by any means, but there is a chance of it improving in the future if reports be true of increased activity in that part of the country. The continental trade is not bulking large, and the number of inquiries are not big. The trade generally is quiet, and there are no signs of a revival at the moment. There is a moderate demand all round, and customers are not inclined to book forward, only taking bare necessities. The makers have got prices down, and there is not much likelihood of a further fall unless it be due to further reduction in railway charges and the price of fuel. There is not much trade in special qualities of iron but the demand is fairly steady.

Iron Ore.

The local ore trade is dull and is likely to remain so until there are more furnaces in blast. Some mines are closed, while others are on part time with a restricted number of men at work. Foreign ore is coming in in moderate quantities, but there is not a great amount of business being done. A cargo arrived from Kirkenes last week.

Steel.

The steel trade remains the same and heavy orders are not held. Workington worked last week in the rail mill, but operations have again been stopped. The Barrow rail and merchant mills are at work, but orders are not plentiful. There is a better business in hoops and small section bars.

SHEFFIELD.

(From our own Correspondent.)

Waiting for the Turn.

THE tide of trade in ordinary steel manufacture is still ebbing, and those engaged in business are still waiting and hoping for a turn which will indicate that it is beginning to flow again. It is recalled that last year things went from bad to worse until about this time, or somewhat later, and then there was an upward movement, which continued and became very pronounced for several months. The effect of that movement has not yet worn off, and orders placed in the early part of the year are still keeping a good many of the furnaces busy. But the demands on those furnaces are not what they were, and the placing of new orders has for some time been on a very limited scale. No signs of improvement are manifest yet, but there are optimists who believe that a change will set in when the holiday season is quite over. At present many of the people who are in a position to give out orders are away. It is also stated that a considerable weight of orders for mild steel is being held up in the belief that prices will come lower. Buyers argue that, when the Ruhr difficulty is settled, cheap French steel will flood our market. British steel makers, on the contrary, are of opinion that such a settlement would have the effect of stiffening the home market. Whichever view may be correct, there is no doubt that a large amount of business will have to be given out somewhere when a solution is found, as consumers of steel are growing short of supplies.

Some Bright Spots.

Things are not by any means as bad as has been stated in some quarters. Last week-end rumours got afloat that certain works in both the Sheffield and the North Lincolnshire districts contemplated closing down, but inquiries failed to establish any grounds for such statements. The United Steel Companies stated that their works in the Lincolnshire district were not likely to be affected, while Lysaghts said that they had quite a lot of work in hand, and had no intention of closing down. One of the works in Sheffield affected by the "closing down" rumour was that of the United Strip and Bar Mills Company, Limited, which is associated with the United Steel firm. A member of the former firm, however, stated that orders were "progressively increasing," and that, although the mills were not, of course, turning out the amount of work they were capable of doing, the number of orders was more than satisfactory considering the present general condition of trade, and was beginning to increase. In the case of William Cooke and Co., of Tinsley, a director explained that while it was still necessary for some mills to be on short time, or even for one mill to be closed down for a week occasionally on account of shortage of orders, the firm was nothing like so short of work as it had been.

Railway and Ship Material.

There is still a large amount of work on hand in the departments producing railway material, the axle and tire plants being engaged up to three-fourths of their capacity. The heavy steel foundries and forges are booking increased work in connection with the building of the new battleships, and both Firths and Hadfields have just received substantial orders for steel of the heaviest type. The forges generally are fairly well employed. Although the motor industry is not by any means fully active, it is yet making considerable demands on the manufacturers of alloy steel, and is also calling for a certain quantity of other steel, as well as tools. There is a better request for various high-speed tool and special steels, but the demand is not nearly up to the limits of productive capacity. An improved demand for edge tools on colonial and South American accounts is reported. As a result of heavy crops of grain and hay, there has been an active demand for scythes.

Cutlery and Plate.

No improvement is to be recorded in the state of the cutlery trade. There is a fair amount of activity in stainless knives of both ordinary table and dessert sizes. Almost all the table cutlery now sold is of the stainless variety, the demand for knives of ordinary steel being a constantly shrinking one. The trade in general cutlery is very slack, and the scissor and razor departments are suffering much depression. On the electro-plate side, some firms are busy on several huge orders which have recently been placed for articles to be given away by proprietors of certain well-advertised specialities.

Chromium Plating.

Electro-plating with chromium is one of the many innovations of recent years, and the latest report with regard to it is that it has now passed the experimental stage and has been brought to such a state of perfection that its value can be gauged on a commercial basis. Chromium is, of course, the ingredient which gives stainless steel its peculiar property, and the expert who has been investigating chromium plating states that it can be electrically deposited on practically any metal, leaving a surface of pure chromium and resulting in a product which has the greatest non-tarnishable, non-stainable and non-rustable properties of any known metal. Further, as chromium is also one of the hardest metals known, the durability is far greater than that of any other metal which has so far been electrically deposited. It is contended that the life of an article plated with pure chromium is indefinite. Whereas all other deposited metals have to be kept bright by constant polishing to remove oxidation, all that is required to keep the surface of pure chromium in its original condition is to wipe it over with a soft cloth. The possibilities of chromium plating are obviously very great. As it can be applied to iron, steel, brass, copper, nickel and aluminium, there seems to be a vast field for its employment.

The New Master Cutler.

Mr. James Neill, who has now been formally elected Master Cutler, and who will be duly installed in the ancient office in October, is a steel maker who has made his own business—one of the few Master Cutlers of whom that can be said. Most of them belong to families which have been associated with Sheffield trade for generations, and have themselves been brought up to the trade. Mr. Neill was neither. Originally an accountant, he started in business as a maker of crucible steel some thirty-five years ago, without practical knowledge of the trade and without a single customer. He has been very successful. Besides crucible steel, his firm now makes hacksaw blades, permanent magnets for magnetos, and other steel goods.

It took up the magnet industry during the war, in response to an appeal by the Government. A letter from the Air Board, received after the conclusion of the war, paid tribute to the thorough investigations and careful experimental work which it had carried out, without which it would not been possible to provide such successful magnets as had been supplied to the Department, and adding that the personal efforts of Mr. Neill himself had been largely responsible for making this country independent of Germany in that important branch of industry. Mr. Neill is sixty-five years of age. Among his chief guests at the Cutlers' Feast he will have the Earl of Derby, Admiral Sir Doveton Sturdee, Lieut.-General Sir Noel Birch and Major-General Sir W. S. Brancker.

Sheffield's Ring Road.

Sheffield Corporation has now nearly completed its great scheme for constructing a wide, tree-lined road all round the city. Since the war, something like 10 miles of first-class road, from 80ft. to 100ft. wide, have been made, and a further couple of miles are now in progress and nearing completion. The work was taken in hand with the dual object of easing the traffic on the busy central streets, with their network of tramlines, and at the same time finding work for the unemployed. About £300,000 has been spent so far, and the sections now in hand will raise the total to £365,000. It is now possible for long-distance traffic, wishing to go from one side of Sheffield to the other—say, from Manchester to Lincoln, or from Leeds to Derby—to do so without touching the centre of the city at all. The new roads are also of advantage to traffic originating in Sheffield itself and bound for outside, as they are connected with the old road system, and can be joined at practically any point of the compass.

NORTH OF ENGLAND.

(From our own Correspondent.)

A More Hopeful Outlook.

Now that the holiday season is practically over traders in the North of England are turning their attention to the prospects for autumn trade. So far there has been little movement in the direction of covering autumn requirements in the iron and steel trades, but a few inquiries are reported, and there is hope of some revival in the near future. There seems to be a belief that prices have touched rock bottom, and if that be so there should soon be an expansion of trade, as a number of orders have certainly been withheld until market conditions became more stable. But it is dangerous to prophesy these days, and the best that can be said is that the outlook is regarded as more hopeful.

Cleveland Iron Trade.

The tone of the Cleveland pig iron market shows a slight improvement, though the actual amount of business being put through just now is not such as to warrant very great optimism. There has been a little more export business—chiefly in hematite—but the stagnant condition of the home industry is reflected in the very limited consumption of pig iron, and consumers are only buying in small parcels. It is not altogether a question of price. Many of the works have not got orders to absorb the pig iron available, and consequently have no need to trouble about supplies. Still the autumn usually witnesses some expansion in the home demand, and pig iron producers are anxiously hoping that this will materialise. The export market, however, presents the more hopeful field for the disposal of pig iron. Fuel shortage on the Continent has caused the stoppage of a number of furnaces in Luxembourg, and the French are also finding coke so scarce and dear that the cost of pig iron production there is steadily rising, with the result that British pig iron producers are likely to benefit by an increased demand from the Continent. With a view to attracting this trade Cleveland makers have made further reductions in their prices. No. 1 foundry iron is now half-a-crown cheaper at 105s., whilst No. 3 G.M.B. has fallen to 100s., No. 4 foundry to 95s., and No. 4 forge to 92s. 6d.

Hematite Pig Iron.

Owing to the recent curtailment of output and a steady improvement in the demand, East Coast hematite pig iron is no longer abundant, though ample for present requirements. Home inquiries are rather better, and a few sales to Germany and Italy are reported. Under such conditions quotations have taken an upward turn, but they are still on a comparatively low level at 98s. 6d. to 100s. per ton for mixed numbers, as in normal pre-war times the price was usually about 8s. above No. 3 Cleveland foundry iron. The quotation of 98s. 6d. is now the minimum that would be accepted either for home use or export.

Iron-making Materials.

Were supplies of foreign ore urgently needed the strike riots at Bilbao and the war in Morocco might cause grave disquiet here, but ironmasters, having made provision for operating a larger number of furnaces, have more ore than they need, and their chief aim is to delay, not to expedite, deliveries under contract. Consequently there is little business, and the price of best Rubio ore is purely nominal at 23s. per ton c.i.f. Tees. The easier conditions in the export fuel market have not brought any relief to the ironmasters in regard to prices, and the best kinds of Durham furnace coke still realise 41s. 6d. per ton delivered at the works, although second qualities have been sold at 40s.

Manufactured Iron and Steel.

The steel works have resumed operations after the holidays, but most of them are still short of work. The outlook, however, is distinctly more hopeful. There is reported to be a little more inquiry for steel from the Far East, and the demand for black and galvanised sheets is so brisk that some of the makers have practically ceased to book orders. Quotations are unchanged.

The Coal Trade.

The tone of the Northern coal trade has improved quite definitely and perceptibly in every direction, and though there is no great alteration in prices as yet, nor expected for some little time, the position of the collieries is certainly better than it was, and they are not inclined to be squeezed to anything like the extent that was possible last week. The turns are full in some cases for a fortnight ahead, and in others they are filling up rather rapidly, so that fitters have stiffened their ideas of values all round. This attitude is supported by an expanding inquiry from abroad, and though actual bookings are on the small side, the threat of the American strike has caused continental buyers to look around for supplies, in view of a possible shortage if that strike takes place. At all events, continental buyers are having it pressed on their minds that present prices have touched bottom, and they are showing a tendency to operate. The financial situation in Germany tends to some extent to disquieten the market. Shippers, however, can now send forward supplies without fear of stoppages of delivery. Northumberland steam coals are in greater demand and producers are more optimistic regarding the outlook. Best qualities are a shade firmer in price, while second steams and smalls are scarce and steadier. The Durham collieries have benefited considerably by an improvement in the demand, and advices from Sweden indicate that the State Railways and gas companies are likely to be in the market for large quantities of steam and gas coals in the course of the next few days. Coking coals and bunker qualities show substantial appreciation. The coke trade is disappointing, and the trend of values is downward for both gas and foundry coke.

SCOTLAND.

(From our own Correspondent.)

Trade Conditions—No Change.

Another week has passed without bringing any change in industrial circles generally. Demands for all classes of material in the shape of steel and iron products are exceptionally scarce and the general outlook is most unsatisfactory. The situation at the shipyards being unchanged, there seems little hope of an early return to normal conditions. Meanwhile the lack of employment is still sending large numbers of skilled workers out of this country in the search for work.

Pig Iron.

The pig iron market remains very dull. There is practically no improvement in the demand, for home requirements, both for hematite and foundry, are exceedingly light, and there is small likelihood of any betterment until the shipyards are again in operation. Export is a little more active, but the total turnover is of small account. The output from the furnaces is not being taken up, and prices continue to ease. Hematite can be bought somewhat below the prices quoted and foundry can also be obtained at cheaper rates than current quotations for a good order.

Steel and Iron.

The steel works have not yet benefited from the reduction in prices. Makers have very few orders on hand either for plates or sectional material. The reduction in prices holds little inducement to consumers who hope ultimately to purchase material considerably below the present level of prices. Sheet makers are fairly busy, and anticipate further orders on export account. The shipping demand for the lighter gauges is regular. Galvanised sheets have not sold so readily of late, but the works have still a good tonnage on hand and are fairly well satisfied with the outlook. The bar iron works have made small progress since the holidays. Inquiries have occasionally stirred the market, but actual business placed has been most disappointing. Re-rolled steel bars, likewise, are poorly bought. Prices are unaltered and are considerably dearer than those for competitive material from abroad. Present conditions of trade, however, prevent much buying of foreign material even at cheaper prices. In scrap material only odd sales are mentioned.

Coal.

The demand for all descriptions of large coal for export has been very indifferent throughout the past week, and business has been difficult to negotiate. This scarcity of orders has caused an accumulation of supplies at the collieries. The offerings of cheap lots have not met with much response, and prices weakened considerably. During the past day or two a little more inquiry has come into the market, and a slightly firmer attitude is noticeable. Practically all shipments are going against old contracts. Washed nuts have a comparatively regular demand at present prices, which are still inclined to weaken somewhat. Aggregate shipments show a decrease, which would have been greater if it had not been for some good bunkering orders. The total for the week amounted to 271,983 tons, against 329,637 tons in the preceding week, and 369,522 tons in the same week last year. The home trade shows little sign of improving. Industrial requirements are weak, and household needs are not up to usual.

Pits Closing.

Reports from the Lothians indicate a fair amount of idle time with a lessening demand for fuel. One or two collieries are closing down, but it is hoped to absorb all the workers in other collieries in the district. It is also reported that a colliery in the Kirkintilloch district is to close down.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

If anything the conditions prevailing in the steam coal trade are slightly steadier, but this may be due to the better arrival of tonnage. Last week numbers of tips were again idle at the various docks, but the position in this respect opened more favourably this week. This in itself is quite sufficient to account for the elimination of weak spots in the market, but whether the improvement is anything more than a mere flash remains to be seen. There has been rather a better inquiry, although the actual amount of buying has been somewhat limited. The American situation has naturally caused a considerable amount of uncertainty, and the latest advices report that the question of whether there will be a settlement or a strike in the anthracite section of the American coalfield on September 1st is absolutely in the balance. In the event of there being a strike the anthracite market on this side will be strengthened, and the dry or semi-anthracitic coals will also be affected, and they in turn will influence other grades of steam coals if the strike is of very long duration. So far as the Continent is concerned the demand for steam coals from this district is still on meagre lines.

Miners' Wages.

It has confidently been predicted that the miners' wages for September and October would be advanced, and in one quarter a labour leader was very sanguine that the increase would amount to 12½ per cent. It will therefore come as a very great surprise now that it is officially announced that the advance is only 3.85 per cent. on the figure for the past two months. The wage rate is governed by the returns for the two months of May and June last, and is now brought up to 41.47 per cent. over the standard rates of 1915. The slight improvement in the rate for the next two months as compared with July and August does not make an appreciable increase when translated into actual cash. So far as can be seen, it means a rise of about 1s. 3d. to 1s. 7d. per week in the case of the day wage men. It is by no means unlikely that the lower-paid workmen will again raise the question of their payment, as their wages do not automatically benefit by the general advance in the wage rate.

Later.

The South Wales coalowners have sent an intimation to the secretary to the workmen's representatives on the Conciliation Board that they have agreed to the extension to October 31st of the subsistence wage which has been operating in the case of the lower-paid workmen from July 1st to August 31st. This is a voluntary act on the part of the owners.

Coal Exports.

Coal shipments to foreign destinations are slow to recover from the holiday and indifferent trading conditions, and last week amounted to 568,803 tons, compared with 459,773 tons for the week ending August 17th, and 470,906 tons for the week ending August 10th. When, however, these figures are compared with the total of 701,300 tons for the week ending May 11th, it will be seen that the trade has a good way to make up.

Coal Trimming Rates.

Trimmers' rates in South Wales have been stabilised, but this is not the case at other ports in the country, and a meeting of the National Trimming Board has been fixed for September 13th to consider the situation. In view of this the men's side on the Trimming Board has issued a questionnaire to the different districts, and this asks the branches whether they are in favour of (1) accepting the employers' demand for a reduction of 22½ per cent. in the tariff and negotiation as to the actual amount; (2) reference of the whole matter as it stands to an arbitration tribunal as offered by the employers; and (3) resistance to any notices the employers may issue regarding enforced reduction, which means strike action. Cardiff, Penarth and Barry trimmers met recently to consider the position and decided that their delegates to the next meeting should be instructed to support the North-East Coast workmen in resisting the proposed reduction.

Ship-repairing.

Reference was recently made to the improvement in the ship-repairing industry in this district. This improvement has been well maintained, and another substantial order has come to South Wales in spite of the keen competition not only from other ship-repairing districts in the country, but also of firms in Holland and Germany. The steamer is the Kurt Hartwig Siemens, of about 1800 tons deadweight, and is a German steamer. It may be said that this is the first big German order to come to South Wales since the war. The order has been secured by Hills Dry Docks and Engineering Company, Limited, of Cardiff, which not only put in the lowest price, but also undertook to effect the repairs in the shortest time. The order will provide work for between 200 to 300 men, principally boilermakers, for about a month.

Current Business.

The tone of the steam coal market is a shade steadier and is due in a measure to the improvement in tonnage supplies and also to a slightly better demand. Prices are not materially effected and rule round about 29s. to 30s. for the best, although some of the leading collieries will not sell ahead at less than 31s. Second qualities vary from 28s. to 29s., but dry coals are quietly very firm and appear to be very well stemmed for some time to come. The best of these coals are quoted at 30s. to 31s., but lower grades range from 27s. 6d. to 29s. 6d. Monmouthshire coals are slightly irregular, and there is no change of any note in small coals or patent fuel and coke. Anthracite coals have lately shown a slight disposition to weaken, but in view of the fears of American trouble they are steadier, especially in the case of nuts and cobbles.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 7 6	—
No. 1 Foundry	5 7 6	—
No. 3 Foundry	5 2 6	—
N.E. Coast—		
Hematite Mixed Nos.	4 18 6	4 18 6
No. 1	4 19 0	4 19 0
Cleveland—		
No. 1	5 5 0	5 5 0
Silicious Iron	5 5 0	5 5 0
No. 3 G.M.B.	5 0 0	5 0 0
No. 4 Foundry	4 15 0	4 15 0
No. 4 Forge	4 12 6	4 12 6
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	
North Staffs. Forge*	—	
„ „ Foundry	5 0 0	—
(3) Northampton—		
Foundry No. 3	4 12 6	
„ Forge	4 3 0	
(3) Derbyshire—		
No. 3 Foundry	4 12 6 to 4 15 0	
Forge	4 5 0	
(3) Lincolnshire—		
Basic	4 15 0	
No. 3 Foundry	4 16 0	
No. 4 Forge	4 14 0	
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	5 10 0 to 5 12 6	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 10 0	—
Best „	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 17 6 to 11 0 0	
Gas Tube Strip	12 10 0 to 12 12 6	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¾in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 0 0	—
Angles	9 10 0	—
Boiler Plates	14 0 0	—
Joists	9 15 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 0 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0†	—
Light „	11 0 0†	—
Billets	9 0 0†	—
Manchester—		
Bars (Round)	10 10 0 to 11 0 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 5 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	12 0 0	—
Midlands—		
Small Rolled Bars	9 10 0 to 9 15 0	
Billets and Sheet-bars	7 15 0 to 8 5 0	
Gas Tube Strip	10 10 0 to 11 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 10 0 to 19 0 0	
Angles	9 15 0	
Joists	9 15 0	
Tees	10 15 0	
Bridge and Tank Plates	10 5 0 to 10 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½
Block Tin (cash)	192 15 0
„ (three months)	193 15 0
Copper (cash)	63 12 6
„ (three months)	64 7 6
Spanish Lead (cash)	24 12 6
„ (three months)	24 12 6
Spelter (cash)	33 0 0
„ (three months)	32 5 0
Manchester—	
Copper, Best Selected Ingots	67 10 0
„ Electrolytic	70 0 0
„ Strong Sheets	98 0 0
„ Loco. Tubes	0 1 1½
Brass Loco. Tubes	0 1 0
„ Condenser	0 1 2½
Lead, English	26 0 0
„ Foreign	25 0 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£21 0 0	9/-
„ 8 p.c. to 10 p.c. „	£20 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£70 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
„ „ 75 p.c.	£20 10 0 scale 6/- per unit	
„ Vanadium	16/0 per lb.	
„ Molybdenum	9/6 per lb.	
„ Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

	Export.
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	19/-
„ „ Ell	20/-
„ „ Splint	21/- to 22/6
„ „ Trebles	24/-
„ „ Doubles	22/6
„ „ Singles	21/6
Ayrshire—	
(f.o.b. Ports)—Steam	19/-
„ „ Splint	21/-
„ „ Trebles	24/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	18/6 to 21/-
Screened Navigation	28/-
Trebles	23/6
Doubles	23/-
Singles	22/6
Lothians—	
(f.o.b. Leith)—Best Steam	20/6
Secondary Steam	19/6
Trebles	23/6
Doubles	23/6
Singles	22/6
England.	
(8) N.W. Coast—	
Steams	31/6
Household	46/6 to 57/6
Coke	46/-
Northumberland—	
Best Steams	22/6 to 23/6
Second Steams	21/- to 22/-
Steam Smalls	16/- to 17/-
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	23/6 to 24/-
Second	21/6 to 22/6
Household	25/- to 28/-
Foundry Coke	55/- to 57/6
Sheffield	Inland.
Best Hand-picked Branch	30/6 to 32/6 —
Barnsley Best Silkstone	26/6 to 28/- —
Derbyshire Best Brights	25/- to 27/- —
„ „ House	22/6 to 23/6 —
„ „ Large Nuts	20/- to 21/6 —
„ „ Small „	15/- to 16/- —
Yorkshire Hards	21/- to 23/- —
Derbyshire „	20/- to 22/- —
Rough Slacks	11/6 to 13/6 —
Nutty „	10/- to 12/- —
Smalls	7/- to 9/- —
Blast-furnace Coke (Inland)	35/- to 36/-
„ „ (Export)	f.o.b. 44/6 to 45/-
(9) SOUTH WALES.	
Cardiff—	
Steam Coals :	
Best Smokeless Large	29/- to 30/-
Second „ „	28/ to 29/-
Best Dry Large	29/6 to 30/6
Ordinary Dry Large	27/- to 29/-
Best Black Vein Large	28/6 to 29/-
Western Valley „	27/6 to 28/6
Best Eastern Valley Large	27/- to 28/-
Ordinary „ „	25/- to 27/-
Best Steam Smalls	20/- to 21/-
Ordinary „	18/- to 20/-
Washed Nuts	30/- to 32/6
No. 3 Rhondda Large	30/- to 32/-
„ „ Smalls	25/- to 26/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/6 to 20/6
„ „ Smalls	15/- to 16/-
Coke (export)	47/6 to 52/6
Patent Fuel	30/- to 33/-
Pitwood (ex ship)	32/6 to 33/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	50/- to 52/6
Seconds	42/6 to 45/-
Red Vein	32/6 to 35/-
Machine-made Cobbles	62/6 to 65/-
Nuts	60/- to 62/6
Beans	45/- to 47/6
Peas	27/6
Breaker Duff	12/6 to 13/-
Rubbly Culm	15/- to 16/-
Steam Coals :	
Large	25/- to 26/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	20/- to 22/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest quotations available.

French Engineering Notes.

(From our Correspondent in Paris.)

Higher Prices.

The further advance in iron and steel prices which it was announced would take place in September owing to the diminishing supplies of coke, has been hastened by the heavy depreciation of the franc as well as by the higher prices ruling in Belgium, where the fall in currency values is causing a serious economic disturbance. Great efforts are being made to keep some of the coke ovens at work in the Ruhr, but the results are far from coming up to expectations, and as so much coke has to be imported from England and the United States, it is impossible to foresee when the advance will end. In these circumstances there is an entire absence of stability in iron and steel prices, and in view of the probability of still higher values for some months to come, consumers are covering future requirements, with the result that the mills and forges are getting very backward with deliveries. During the past week one sheet rolling mill, making a speciality of extra mild black sheets, has raised its prices by 150f. per ton. The situation is, therefore, by no means unsatisfactory to mill and forge owners who have sold forward their production, and the fact that so much is going into consumption at a time when ferro-concrete is employed so largely for structural purposes on account of the lower cost, testifies to the activity of constructional work generally. As a matter of fact, the only thing that appears likely to check the inflation of prices is the putting on the market of the considerable quantities of rolled iron and steel that have been seized in the Ruhr; but as these stocks are to be disposed of by a committee which will look after the interests of French manufacturers, it may be assumed that the stocks will be absorbed gradually in a way to minimise, as much as possible, the effect upon prices.

Suction Gas Lorries.

Since the trials of suction gas plants for heavy vehicles, which were carried out last year, with results that proved a remarkable economy in fuel consumption as compared with petrol, the transformation of lorries and tractors for use with suction gas producers has become quite a profitable branch of industry. The agricultural tractor has entirely lost its vogue on account of the fuel cost being too high to make these vehicles pay for tillage work, and the cheapness of suction gas appears to open the way for a renewed popularity of the tractor if only users can be assured of its reliability. The experience of the past year has certainly strengthened the claims made on behalf of the suction gas lorry and tractor which, it is affirmed, do not require more than ordinary care. More time has to be spent in keeping the plant clean and in good order, but the economy is so considerable that the plant is paid for in a few months, and the only thing needed to make the system a success is to adapt slower running engines which will give a higher efficiency than the ordinary type of petrol engine running on gas. It is in the hope of securing a better utilisation of suction gas on lorries and tractors that the Comité Central de Motoculture, which has been formed as a department of the Ministry of Agriculture, is organising a series of trials of lorries and tractors equipped with suction gas plants using wood or charcoal as fuel. The tractors will be tested for ploughing during September on a field at Essonnes (S. and O.), and the engines and gas producers will be subsequently tested on the bench in the laboratory of the Automobile Club de France. While suction gas for motor vehicles appears to be making headway, a further test of engines using vegetable oils is also to be carried out. There will be a class of engines, such as those of the Diesel and hot bulb types, adapted for running on vegetable oils, and ordinary internal combustion engines fitted with carburetters or pulverisers for the use of such fuels. There are already plenty of engines capable of running satisfactorily on palm oil and the oil of ground nuts, &c., but the cost of vegetable oils is far too high for economical use, and it will obviously be a long while before there can be any prospect of colonial fuels replacing mineral oils. For the time being suction gas offers the most promising solution of the problem of cheap motor traction, and it is believed also that it will be equally satisfactory in the Colonies where vegetable oils are obtainable at a low price.

Moving Platforms.

The experiments with the three systems of moving platforms, which have been selected from those presented for competition to the Paris Municipal Council, are to be carried out, first, in the works where they are to be constructed. They will then be installed in a suitable place for the temporary service of the public, which will decide definitely upon the practical value of the systems. It is expected that the public demonstration will take place early next year. The competition has passed through a good many vicissitudes since it was first instituted with the promise of a considerable sum for the laying down of a moving platform in one of the most frequented streets of Paris. After much discussion, which showed that opinion was divided as to the advisability of spending money for the purpose, a sum was voted and subsequently withdrawn, and, finally, the Council decided to devote 150,000f. to the construction of an experimental platform. With this sum it was obviously impossible to lay down three separate platforms, and as they are all based upon the same principle, and differ only in their method of speed variation, it has been decided to lay down the platforms together for a length of about 20 m. The systems themselves are regarded as practicable, and the main point to be considered is the facility offered for stepping on and off. However good a system may be it will fail to be a complete success if nervous people will not make use of it, and the technical committee, which will carry out the experiments, desires to be absolutely sure that there will be no objection to the proposed method of transport.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

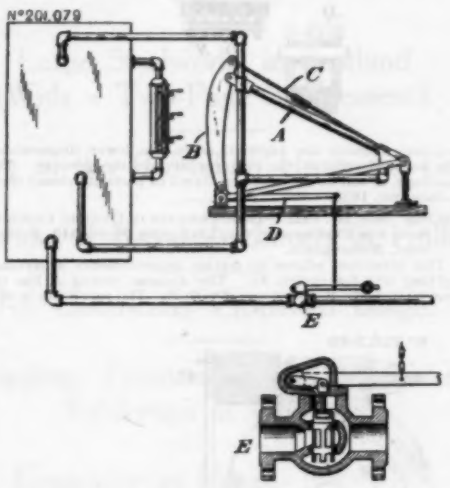
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

201,079. October 4th, 1922.—Feed Water Regulators, *E. C. R. Marks, 57 and 58, Lincoln's Inn-fields, London, W.C.*

The inventor claims that this feed water regulator can be made more compact than is usually the case with devices of this type. The tube A is connected at the top with the steam space of the boiler and at the bottom with the water space. This tube will expand as the water level falls, on account of a greater part of its length being exposed to the heat of the

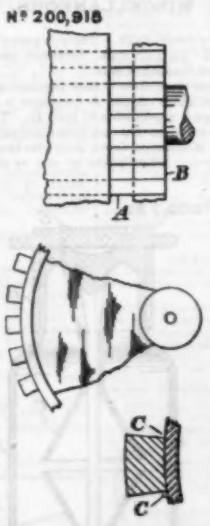


steam. As it expands the tube will push out the lever B, which is anchored at the top by the tie rod C, and, through the medium of the bell-crank lever D, will open the feed valve E. The reverse action will, of course, take place when the water level rises. The feed valve is of the balanced type, as shown, in order to reduce the work required for its operation.—*July 26th*, 1923.

DYNAMOS AND MOTORS.

200,918. April 21st, 1922.—Improvements in or relating to Electrical Machinery Applicable more Especially to Squirrel Cage Rotors, Joseph Jones, of 18, Canal-street, Nottingham.

This invention relates to a method of connecting the windings or conductor bars of electrical machines, such as squirrel-cage motors. The conductor bars which project from the end of a squirrel-cage rotor are shown at A, and B is the short-circuiting or collector ring, which fits inside the bars. Connec-

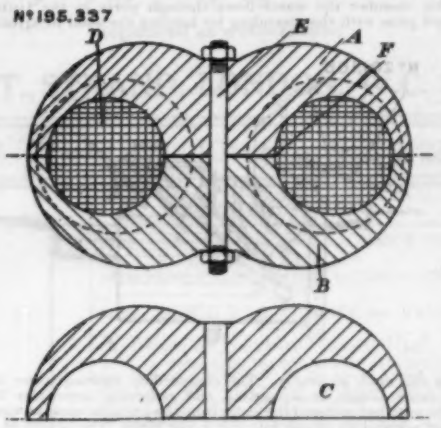


tion between the bars A and the ring C is made by brazing or silver soldering, a fillet also being provided, as shown at C. The inventor points out that the jointing does not depend upon mechanical interconnection, and is thus distinguished from the ordinary systems in which the parts are dovetailed together or let into one another.—*July 23rd*, 1923.

TELEGRAPHS AND TELEPHONES.

195,337. March 4th, 1922.—Improvements in Loading Coils for Telephone Lines and the Like, Forges et Ateliers De Constructions Electriques, Dr. Jeumont, 73, Boulevard Hassmann, Paris.

The improved loading coil described in this specification comprises a magnetic circuit in the form of a complete protective outer covering, and is formed of a mixture of iron filings of magnetic power agglomerated by means of an insulating material. A winding made beforehand, and comprising all the circuits required by the loading apparatus, is enclosed in the outer covering. The magnetic circuit is formed of two dish-shaped portions A and B, each having a circular groove C. The coil D is placed in position, as shown in the upper drawing, the two portions of the magnetic circuit being held together by an

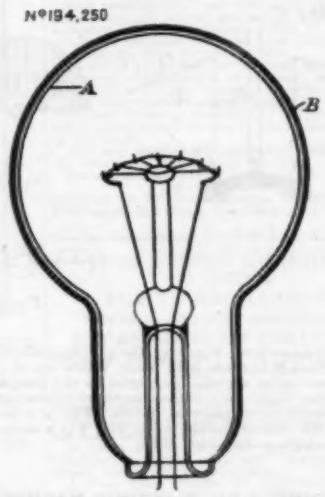


insulating bolt E. An air gap may, if necessary, be provided at F. The dotted lines in the upper drawing show the path of the magnetic flux.—*July 26th*, 1923.

LIGHTING AND HEATING.

194,250. April 21st, 1922.—Improved Manufacture of Electric Lamps with Diffusing Globes, N. V. Philips, Gloeilampenfabrieken, of Eindhoven, Netherlands.

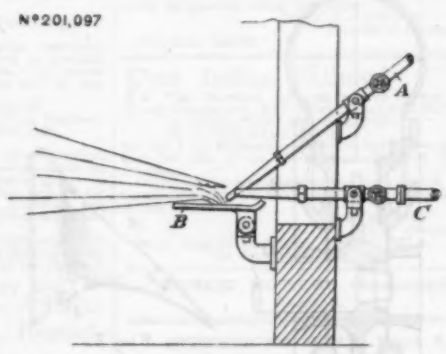
It has been proved, this specification states, that opal glass used in the ordinary way has a bad influence on the life of electric lamps, and the object of this invention is to avoid this



trouble. The globe of the new lamp, which may be of the gas-filled type, consists of two layers. The inner layer A is composed of ordinary clear glass, while the outer layer B is made of light diffusing opal glass.—*July 23rd*, 1923.

201,097. December 6th, 1922.—Oil Burners, I. Altshyller, 75, Blenheim-street, Newcastle-on-Tyne, R. H. Osterman, and D. V. Krance, of 34-36, Broad Chare, Newcastle-on-Tyne.

In this burner the oil is supplied by the pipe A and is fed on to the plate B. A supply of steam is provided by the pipe



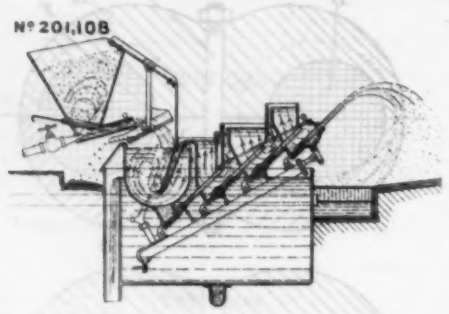
C. Both pipes and the plate are provided with swivel adjustments, while there are control valves for the steam and oil, as shown.—*July 26th*, 1923.

WATER PURIFICATION.

201,108. January 16th, 1923.—Sand Washing Apparatus, J. Peebles, Ayr Corporation Works, Dalrymple, Ayrshire.

The apparatus comprises an overhead hopper into which the foul sand is first placed and from which it is propelled by a jet of water on to a vibrating screen which separates out stones. The sand and water from the screen fall into a main separator beneath, in which the sand is kept in agitation by a jet of water and from which it is propelled in turn through a following series of finishing chambers and passages arranged in ladder or step-like form by propelling jets of water. These finishing chambers are so constructed that the exhaust water from the propelling jets is made to flow backwards through the chambers, so that it is utilised as washing water and throws down the sand to the bottom of each chamber into which the propelling jet has carried it. This counterflow of the washing

water is still further utilised before it is allowed to escape from the apparatus by so arranging the series of finishing chambers that the discharge from the lowest one is led into a supplementary chamber behind the baffle plate in the main separator. From this chamber the water flows through ports in the bottom, and joins with the ascending jet keeping the sand in agitation

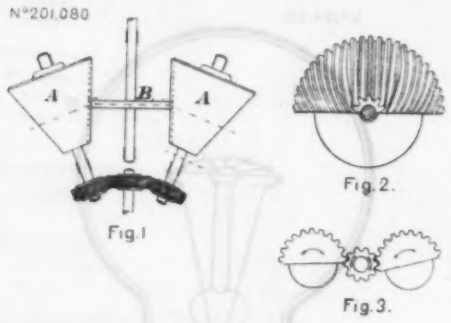


in the main separator. The counterflow washing water thus further assists in separating and removing impurities from the sand before it and the water from the jet in the main separator are allowed to escape into the lower tank. The action of the apparatus can be followed with the help of the arrows in the drawing.—*July 26th*, 1923.

TRANSMISSION OF POWER.

201,080. October 11th, 1922.—Change Speed Gear, C. Stefani, Via Vanvitelli 102, Milan, Italy.

This change speed gear is a modification of a well-known type of friction gear, but in it there are employed two conical-toothed wheels A A toothed across their whole width around substantially one-half only of the conical peripheral surface, whereby a full number of teeth of the same pitch are obtained around one-half, or thereabouts, of the periphery of each conical

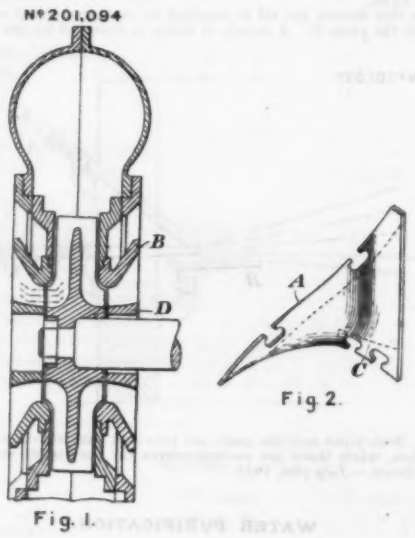


wheel at all diameters. Moreover, the intermediate or cylindrical toothed wheel B is made with teeth, which are of rhomboidal form in section on a plane tangential to the periphery of the wheel, so that engagement of these teeth with those of the conical toothed wheels takes place at points. Fig. 2 is an end view of one of the conical wheels, while Fig. 3 is a section through the three wheels.—*July 26th*, 1923

PUMPING AND BLOWING MACHINERY.

201,094. November 28th, 1922.—Centrifugal Compressors, *The British Thomson-Houston Company, Limited, Crown House, Aldwych, London, W.C. 2.*

This invention is concerned with the inlet guide vanes of centrifugal blowers. One of the vanes is shown, in perspective, in Fig. 2. The edge marked A is cast into the ring B of the inlet,

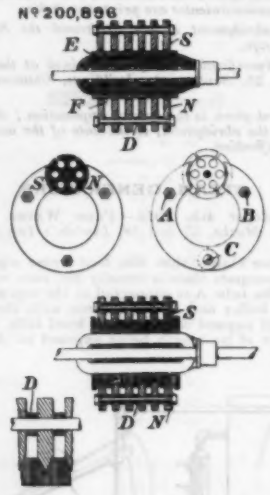


while the edge C is cast into D. The vane is so curved that the air is delivered to the edge of the impeller at the peripheral speed of the impeller blades at all distances from the centre of rotation.—*July 26th*, 1923.

MOTOR CARS AND ROAD TRAFFIC.

200,896. April 19th, 1922.—Improvements in Magneto Electric Machines, Hans Kaupmann, of Worringerstrasse, 79, Dusseldorf, Germany.

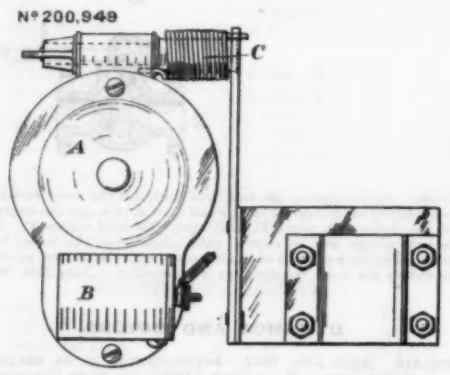
The field system of this magneto is composed of a number of permanent magnets S N, which are connected together by non-conducting bolts A, B and C and collars D. The core E is composed of iron sheets separated from one another by non-magnetic discs F of considerable thickness, so that each group of plates rotates between the poles of a single permanent magnet. In some cases each of the core sections is grooved,



and the magnets are tapered, as in the lower illustrations. The tapered ends of the magnets fit into the grooves. The windings, it will be noticed, are placed in partially closed slots. —*July 19th*, 1923.

200,949. May 1st, 1922.—Improvements in Dynamo Lighting Sets for Cycles and the Like, Guy Storr, 349, Bristol-road, Birmingham.

This invention relates to certain improvements in dynamo lighting sets for cycles, &c. The dynamo casing A has the rear lamp body B cast integral with it. The rear lamp is of a

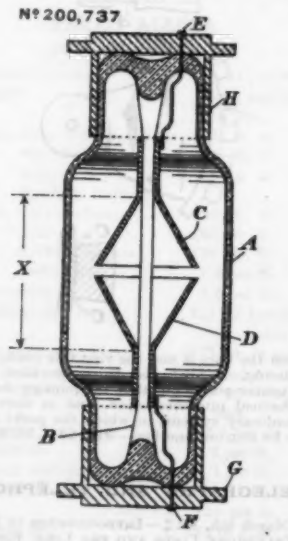


compact and light construction in order that the combined dynamo and lamp shall not be too heavy. A spring C presses the pulley of the dynamo on the wheel of the vehicle. The specification also gives a detailed description of the lamp holder —*July 26th*, 1923.

MISCELLANEOUS.

200,737. February 19th, 1923.—Improvements in or relating to Vacuum Tube Devices, Siemens and Halske Aktien-gesellschaft, of Siemensstadt.

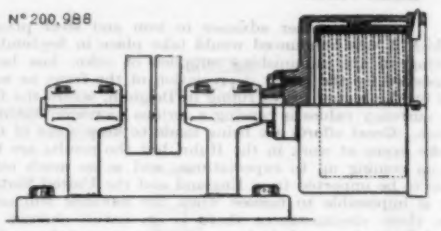
This specification describes a new lightning arrester enclosed in a vacuum. The glass casing A contains a glass rod B which carries funnel-shaped electrodes C and D. The leads E and F connect the electrodes to the current-carrying caps G and H. During a current discharge from one electrode to the other a spark discharge or arc takes place at one or more points during



the time of discharge between the edges of the funnels. The constancy of the insulation is ensured by the creeping distance X between the two electrodes being very much increased as compared with the arc distance. This is due to the fact that the insulating member which forms the distance piece between the electrodes (*i.e.*, the glass stem) is only connected with the electrodes at the base of the funnel-shaped cavity.—*July 19th*, 1923.

200,988. June 2nd, 1922.—Manufacture of Wire, S. C. Harrison and F. Deming, Bradford-street Works, Bradford-street, Birmingham.

The inventors propose to make the strip used for drawing down to wire of brass, copper, or other ductile metal, by casting



it centrifugally in a spirally grooved mould. The mould is made in halves so that the spiral may be readily removed and straightened before rolling and drawing down to wire.—*July 26th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Municipal and County Engineers : North-Western District.—County Offices, Preston. District meeting. 3.15 p.m.

FRIDAY, AUGUST 31ST, TO SATURDAY, SEPTEMBER 22ND.

Shipping and Engineering Exhibition at Olympia.

SATURDAY, SEPTEMBER 1ST.

Institution of Municipal and County Engineers.—South Western District meeting to be held at Plymouth. 2.15 p.m.

SATURDAY TO SATURDAY, SEPTEMBER 1ST TO 8TH.

Institution of Naval Architects.—Summer Meeting in Holland.

MONDAY TO THURSDAY, SEPTEMBER 10TH TO 13TH.

Institute of Metals.—Autumn Meeting at Manchester.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 12TH TO 19TH.

British Association.—Meeting at Liverpool.

MONDAY AND TUESDAY, SEPTEMBER 17TH AND 18TH.

Iron and Steel Institute.—Autumn meeting at Milan.

MONDAY, SEPTEMBER 17TH, TO WEDNESDAY, OCTOBER 3RD.

National Gas Exhibition at Bingley Hall, Birmingham.

EDUCATIONAL INTELLIGENCE.

A Goldsmid entrance scholarship of the value of £120—£40 a year for three years, subject to satisfactory progress—tenable in the Faculty of Engineering of University College, London, will be awarded in September. Entry forms must be received by the Secretary of the College not later than September 8th. In connection with the examination for the scholarship, five bursaries may be awarded to engineering students who require financial help to enable them to take a university course in engineering.

The work of the Ramsay Memorial Department of Chemical Engineering at University College, London, will begin in October, 1923. This department has been instituted with the object of enabling young graduates in chemistry and engineering, who have already obtained a good training in the fundamental sciences of chemistry, physics and mathematics, to direct their studies and investigations towards the application of the principles of physical chemistry to the scientific design and operation of the apparatus and processes of chemical industry in general. Mr. E. C. Williams, M.Sc., of the University of Manchester, has been appointed Professor in charge of the department. The University College Committee will shortly appoint an assistant lecturer in the department. The assistant lecturer must have had an engineering training. The commencing salary will be either £350 or £400, according to the previous training and experience of the man appointed.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The address of the Liverpool Engineering Society has been changed to 9, The Temple, Dale-street, Liverpool.

Mawdsley's Limited, of Dursley, Gloucestershire, ask us to state that they have appointed Mr. Alex. R. Mumday, of 41, Chichester-street, Belfast, as their agent for the whole of Ireland.

The Continuous Reaction Company, Limited, a constituent company of Nobel Industries, Limited, which until recently had offices at 155, Church-road, Battersea, S.W. 11, has now removed its offices to Newton Works, Hyde, Cheshire, to which it is requested that all correspondence should be sent.

We are asked to state that the Blackfriars Foundry Requisite and Equipment Company, Bridge House, 181, Queen Victoria-street, London, E.C. 4, has been appointed London agent, and Grimes More and Co., 11, Bothwell-street, Glasgow, have been appointed Scottish agents for the sale of Pneulec moulding machines and requisites.

We are asked to state that the Aston Martin car which broke the standing-half-mile, standing-kilometre and standing-mile records at Brooklands on Tuesday, August 21st, was fitted with a Zenith carburetter. The Avro machine that was first in the Aerial Derby handicap, with a Hispano Viper engine, also had a Zenith carburetter, as did the winning Siddeley Siskin aeroplane in the circuit of Great Britain for the King's Cup.